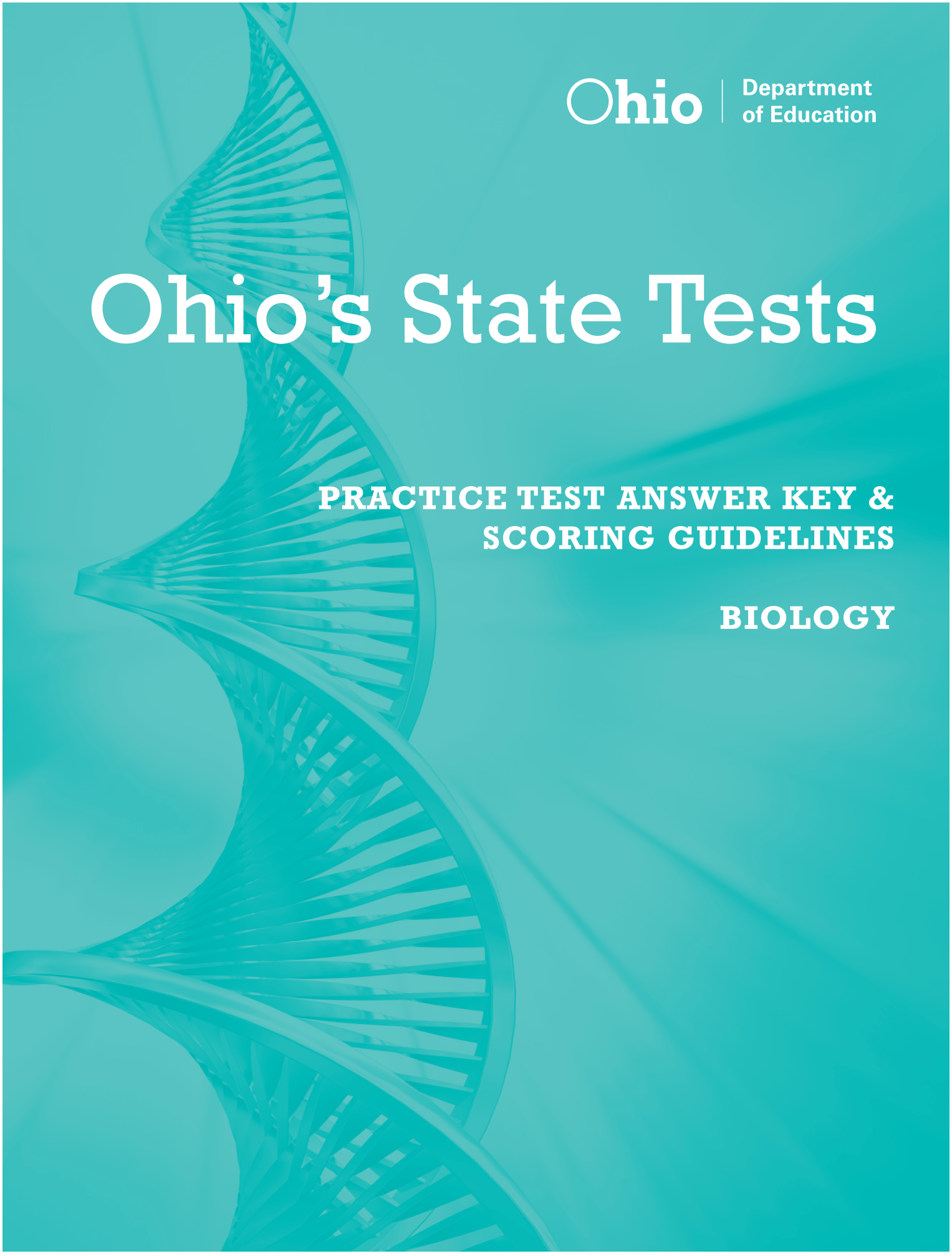
Ohio | Department of Education

Ohio's State Tests

PRACTICE TEST ANSWER KEY & SCORING GUIDELINES

BIOLOGY



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Practice Test
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Biology
Practice Test
Content Summary and Answer Key

Question No.	Item Type	Topic	Subtopic	Answer Key	Points
12	Multiple Choice	Heredity	Genetic Mechanisms and Inheritance	C	1 point
13	Multi-Select	Cells	Cell Structure and Function	A; D; F	1 point
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21	Matching	Diversity and Interdependence of Life	Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.	---	1 point
22	Graphic Response	Heredity	Mutations	---	1 point
23	Multiple Choice	Diversity and Interdependence of Life	Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.	B	1 point
24	Multi-Interaction Item	Evolution	Diversity of Life	---	1 point

*The Simulation is numbered but not scored.

Biology
Practice Test

Question 1

Question and Scoring Guidelines

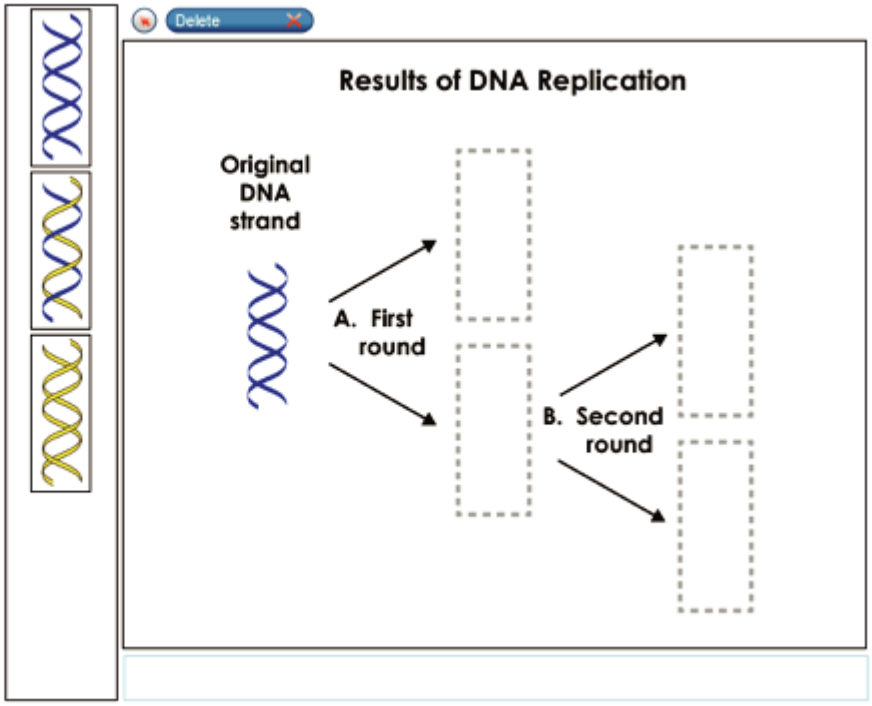
Question 1

The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Blue and Yellow" DNA in each box after the first round (1 point)

  AND

- One "Blue and Yellow" DNA in either box and one "Yellow and Yellow" DNA in the other box after the second round (1 point).

For this item, a partial-credit response includes:

- Placing a "Blue and Yellow" DNA in each box after the first round (1 point)

  OR

- Placing a "Blue and Yellow" DNA in the bottom first round

  AND

- Placing one "Blue and Yellow" DNA and one "Yellow and Yellow" DNA in either of the boxes after the second round (1 point).

Alignment

Topic
Heredity

Subtopic
Structure and function of DNA in cells

Content Elaboration
Life is specified by genomes. Each organism has a genome that contains all of the biological information needed to build and maintain a living example of that organism. The biological information contained in a genome is encoded in its deoxyribonucleic acid (DNA) and is divided into discrete units called genes.

Genes are segments of DNA molecules. The sequence of DNA bases in a chromosome determines the sequence of amino acids in a protein. Inserting, deleting or substituting segments of DNA molecules can alter genes.

An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm or have little or no effect on the offspring's success in its environments.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

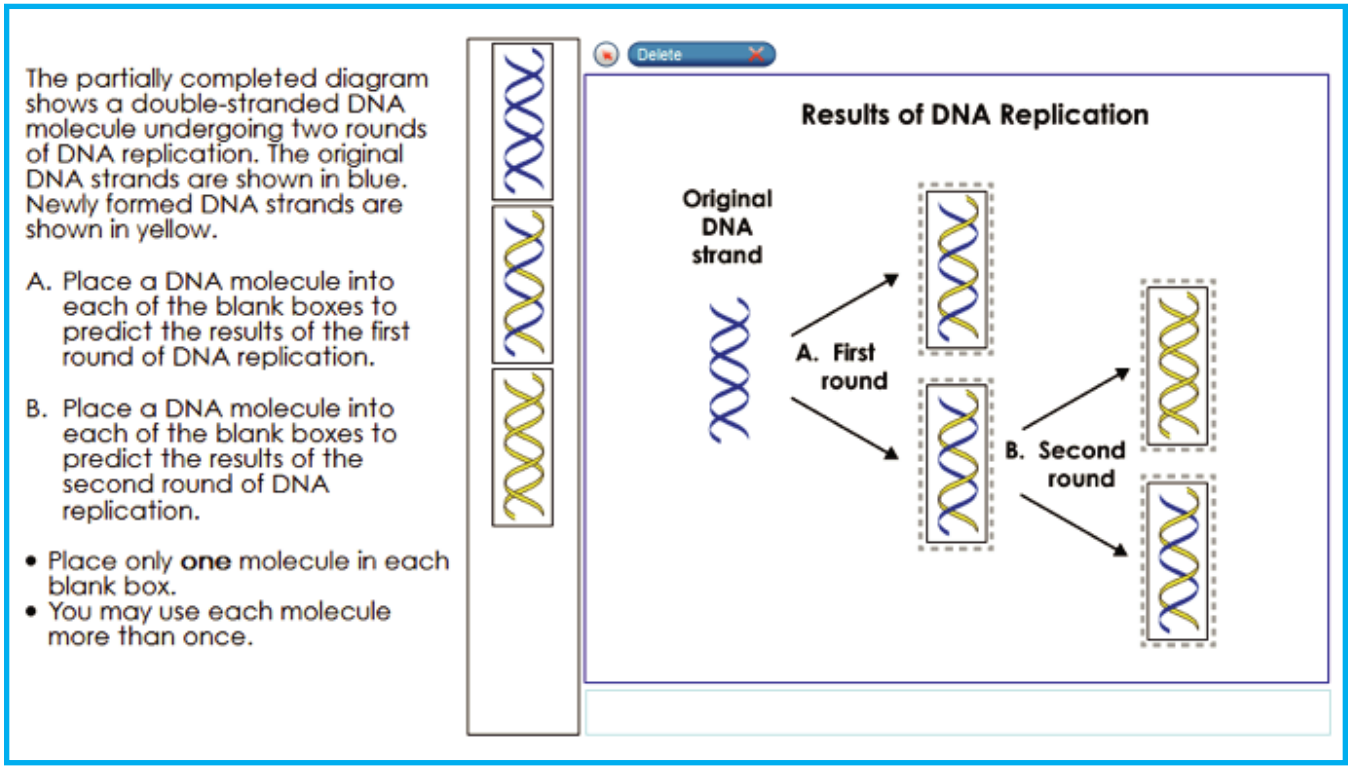
Explanation of the Item
This item requires the student to understand how original DNA strands and new DNA strands are distributed during two rounds of DNA replication. When DNA replicates, an original strand serves as the template for the nucleotides to sequence for the complementary strand. In the first round of DNA replication, there should be a blue and yellow double helix in both boxes. In the second round of DNA replication, a blue strand serves as the template and a yellow strand serves as a template. The newly formed DNA strand is yellow. There should be one blue and yellow double helix and one completely yellow double helix in the boxes provided. The placement of these DNA samples does not impact scoring.

Biology
Practice Test

Question 1

Sample Responses

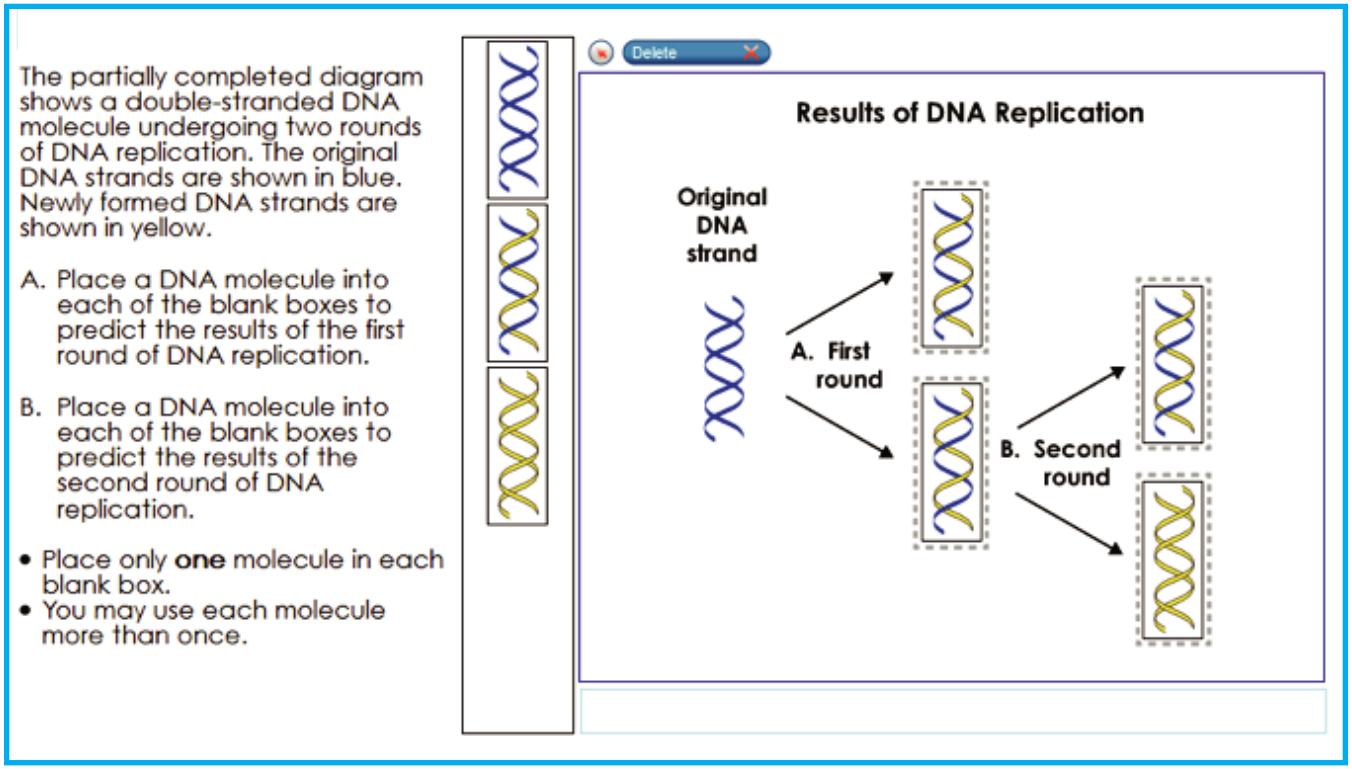
Sample Response: 2 points



Notes on Scoring

This response earns full credit (2 points) because it selected the blue and yellow DNA to illustrate what happens after the first round of replication. The blue strand serves as the template, and the yellow strand is newly formed DNA. The second round of replication correctly illustrates a blue and yellow DNA strand (double helix) and a completely yellow DNA strand (double helix). The placement of the resulting DNA does not impact scoring.

Sample Response: 2 points



Notes on Scoring

This response earns full credit (2 points) because it selected the blue and yellow DNA to illustrate what happens after the first round of replication. The blue strand serves as the template, and the yellow strand is newly formed DNA. The second round of replication correctly illustrates a blue and yellow DNA strand (double helix) and a completely yellow DNA strand (double helix). The placement of the resulting DNA does not impact scoring.

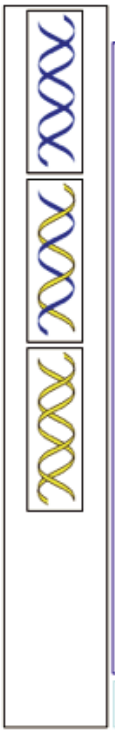
Sample Response: 1 point

The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

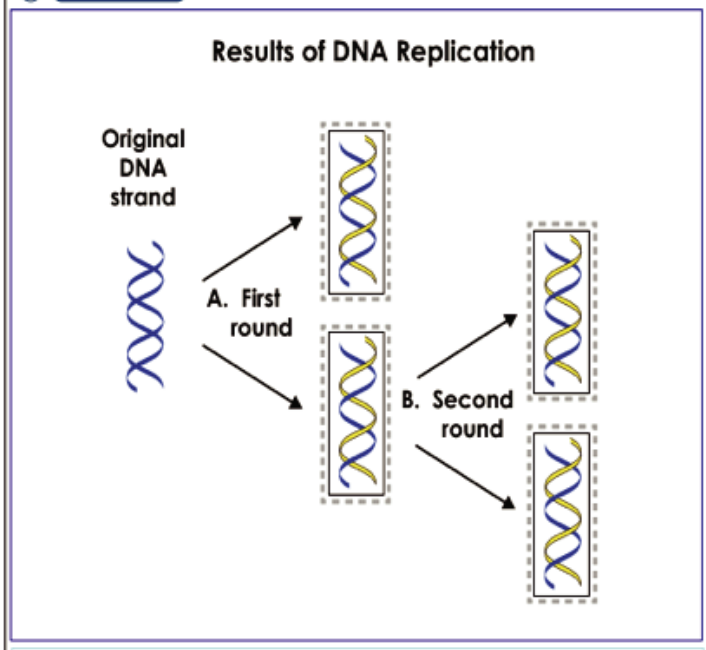
A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.



Delete



Notes on Scoring

This response earns partial credit (1 point) because it correctly selects the blue and yellow DNA strands for the first round of replication. The second round of replication does not receive credit because only one DNA strand would be blue and yellow. The other one would be completely yellow.

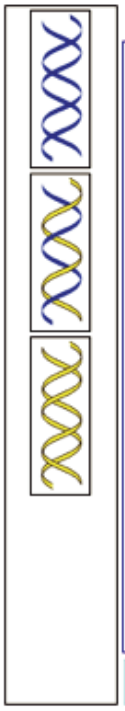
Sample Response: 1 point

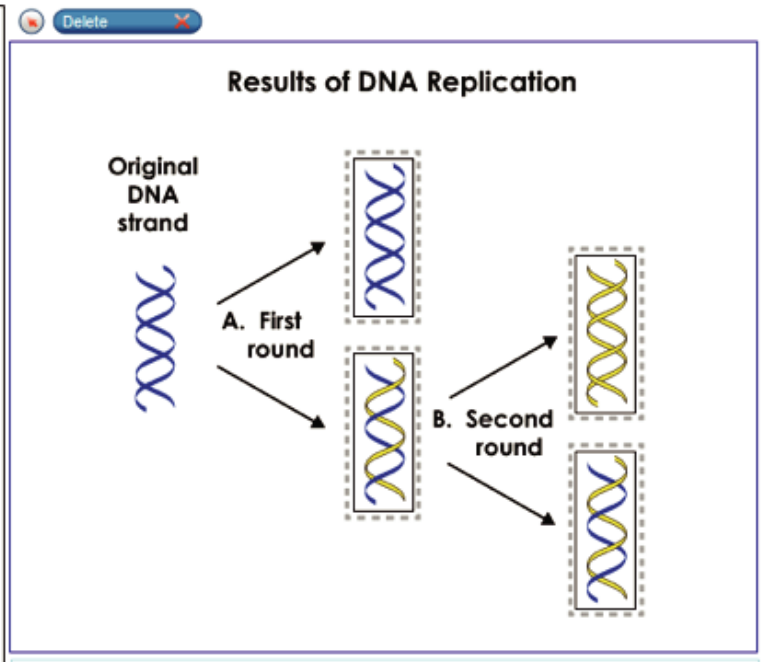
The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.





Notes on Scoring

This response earns partial credit (1 point) because it correctly selects the blue and yellow DNA strands and the yellow strand of DNA for the second round of replication. The first round of replication does not receive credit because both DNA strands would be blue and yellow.

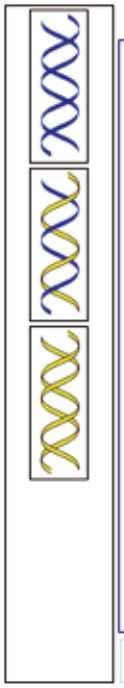
Sample Response: 1 point

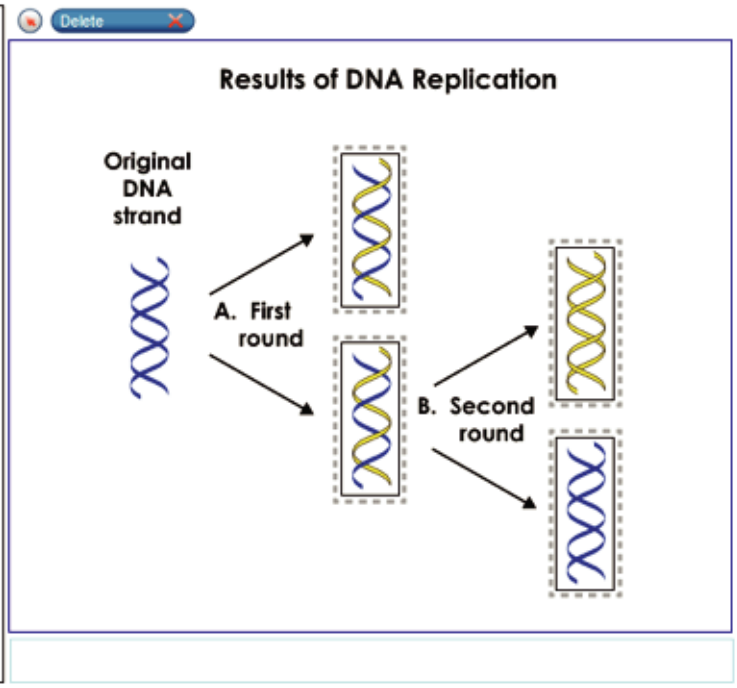
The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.





Notes on Scoring

This response earns partial credit (1 point) because it correctly selects the blue and yellow DNA strands for the first round of replication. The second round of replication does not receive credit because one of the DNA strands would be blue and yellow and the other one yellow.

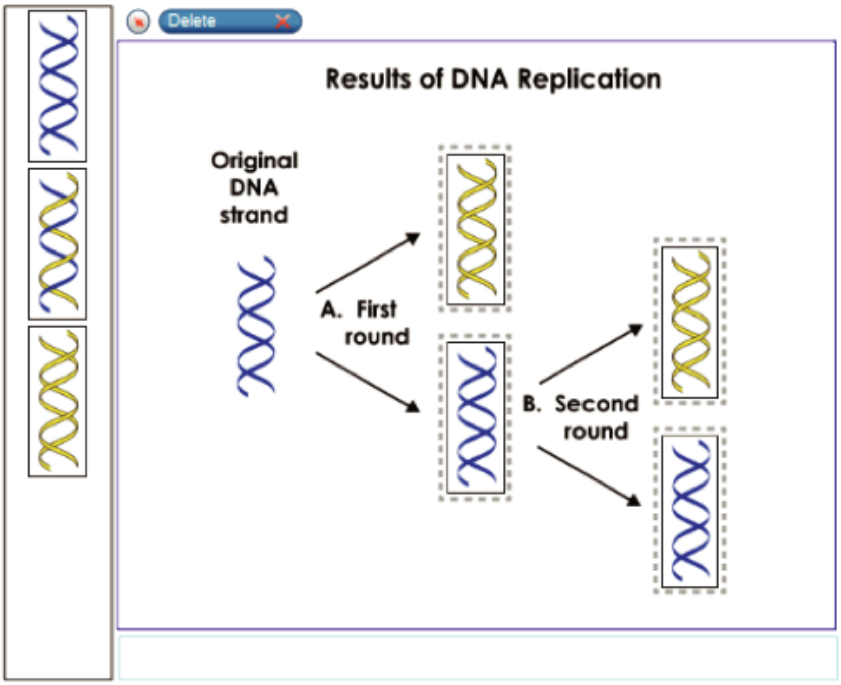
Sample Response: 0 points

The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.



Notes on Scoring

This response earns no credit (0 points) because it fails to select the blue and yellow DNA strand for both boxes after the first round of replication. It also incorrectly selects the DNA strands for the second round of replication. From Sample B, the selected DNA strands would not match the predicted pattern identified in the item.

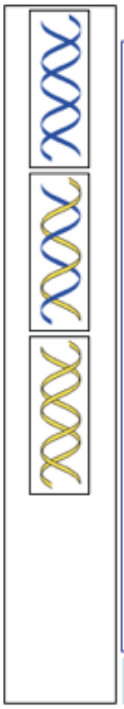
Sample Response: 0 points

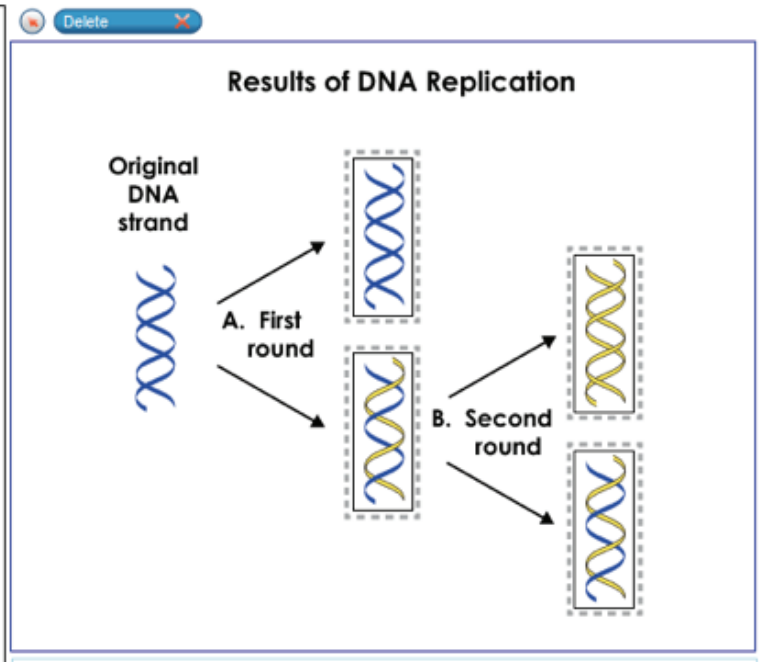
The partially completed diagram shows a double-stranded DNA molecule undergoing two rounds of DNA replication. The original DNA strands are shown in blue. Newly formed DNA strands are shown in yellow.

A. Place a DNA molecule into each of the blank boxes to predict the results of the first round of DNA replication.

B. Place a DNA molecule into each of the blank boxes to predict the results of the second round of DNA replication.

- Place only **one** molecule in each blank box.
- You may use each molecule more than once.





Notes on Scoring

This response earns no credit (0 points) because it fails to select the blue and yellow DNA strand for both boxes after the first round of replication. It also incorrectly selects the DNA strands for the second round of replication. From Sample B, the selected DNA strands would not match the predicted pattern identified in the item.

Biology
Practice Test

Question 2

Question and Scoring Guidelines

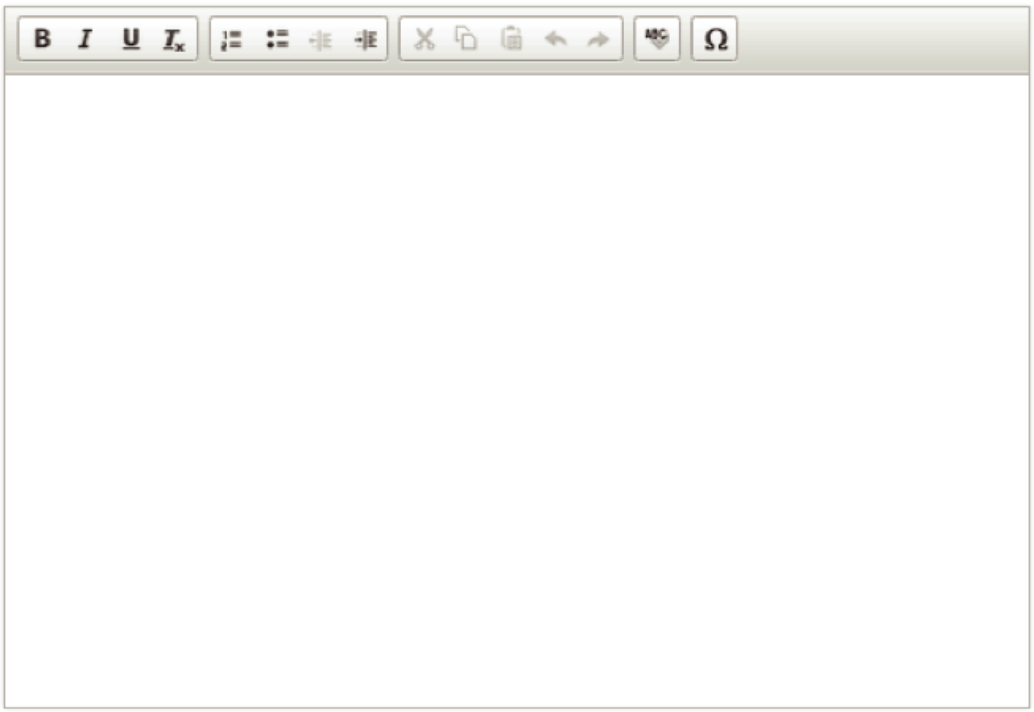
Question 2

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

Score Point	Description
2 points	The response provides essential aspects of a complete interpretation and/or a correct solution. The response thoroughly addresses the points relevant to the concept or task. It provides strong evidence that information, reasoning and conclusions have a definite logical relationship. It is clearly focused and organized, showing relevance to the concept, task and/or solution process. The response correctly • describes the results of a test for the presence of the gene in the nerve cell and muscle cell; AND • describes the cellular process required to express a gene.
1 point	The response provides evidence of a partial interpretation and/or solution process. It demonstrates an incomplete understanding of the concept or task. It contains minor flaws in reasoning. It neglects to address some aspect of the concept or task. The response correctly • describes the results of a test for the presence of the gene in the nerve cell and muscle cell; OR • describes how protein synthesis is required to express a gene.
0 points	The response does not meet the criteria required to earn one point. The response indicates inadequate or no understanding of the task.

Alignment

Topic
Heredity

Subtopic
Cellular Genetics

Content Elaboration
Life is specified by genomes. Each organism has a genome that contains all of the biological information needed to build and maintain a living example of that organism. The biological information contained in a genome is encoded in its deoxyribonucleic acid (DNA) and is divided into discrete units called genes.

Genes code for protein. The sequence of DNA bases in a chromosome determines the sequence of amino acids in a protein.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to compare and contrast the DNA and proteins in two different types of cells from the same organism and describe how protein synthesis is related to the expression of a gene. Looking at the protein in the Na^+-K^+ pump in nerve and muscle cells in a pig, the genes will be the same. The gene is expressed by protein synthesis because DNA is transcribed to mRNA. Then the mRNA moves to a ribosome in the cytoplasm where it is translated into a Na^+-K^+ pump protein.

Biology
Practice Test

Question 2

Sample Responses

Sample Response: 2 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The scientist should find that both cells should have the gene needed to produce the protein in the 'na+-K+ pump. In order for that gene to be expressed it must first undergo transcription and become an mRNA which must then undergo translation to be expressed as a protein.

Notes on Scoring

This response earns full credit (2 points) because it correctly states that "both cells should have the gene needed to produce the protein… ." It goes on to explain that the gene "must first undergo transcription and become an mRNA which must then undergo translation to be expressed as a protein."

Sample Response: 2 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The scientists should see the exact same DNA sequence in each cell. Each cell in the same organism has the same DNA sequnce. This DNA sequnce is used to make proteins though portein synthesis. The DNA is transcribed to mRNA. Then the mRNA moves to a ribosome in the cytoplasm. In the ribosome, it is translated. tRNA brings the correct anti codon for each amino acid, as well as the correct amino acid for the mRNA. Three nucleotide bases on the mRNA acount for one amino acid. As the amino acids continue to come a protein is build by binding the amino acids with peptide bonds. However, not every protein is made every single time. Ou bodies have a way of just using protein synthesis on just a partial part of DNA, so that only a certain protein is synthesized.

Notes on Scoring

This response earns full credit (2 points) because it correctly addresses both tasks of the item. The first: "Each cell in the same organism has the same DNA sequence." The second: "The DNA is transcribed to mRNA. Then the mRNA moves to a ribosome in the cytoplasm. In the ribosome, it is translated. tRNA bring the correct anti codon for each amino acid, as well as the correct amino acid for the mRNA… ." The response goes on to provide more details about protein synthesis.

Sample Response: 1 point

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The scientists should see that the nerve and muscle cells both have the gene that produces the protein in the Na+-K+ pump. Protein synthesis is required to express this protein in the pump, because if not synthesized the protein could not express the gene properly, and mutations are more possible.

Notes on Scoring

This response receives partial credit (1 point) for addressing the first task correctly: "…both have the gene that produces the protein in the Na^+-K^+ pump." The second point is not earned because the response fails to describe how protein synthesis is required to express the gene for the Na^+-K^+ pump: "Protein synthesis is required to express this protein in the pump… the protein could not express the gene properly… ." This response does not indicate how the gene is expressed and is too vague to receive credit.

Sample Response: 1 point

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The results scientist should see if they test both cells for the presence of the gene are that the DNA and proteins from the different types of cells are the same when compared. Protein synthesis is required because it makes the protein.

Notes on Scoring

This response receives partial credit (1 point) for indicating "…that the DNA and proteins from the different types of cells are the same when compared." The response does not provide enough information to claim the second point.

Sample Response: 1 point

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

The two different cells in the Na+-K+ pump of the pig's nerve and muscle cells should present the same gene that produces the pump in the organism. This is vbecause the Na+-K+ pump is found in both the nerve and muscle cells, so they must code for the same protein for the pump. Protein synthesis is required to express the gene that produces this protein in the Na+-K+ by forming complementary amino acids in groups of bases for the protein, called anti codons, then connecting them together to form the proteins in amino acid chains.

Notes on Scoring

This response earns partial credit (1 point) for stating "… the pig's nerve and muscle cells should present the same gene that produces the pump in the organism." The second point is not earned because the response does not provide enough detail to describe how protein synthesis is required to express the gene for the Na^+-K^+ pump.

Sample Response: 0 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

1. The result scientists should see if they tests both cells for the presence of the gene that produces the protein in the pump would maybe be the same since the pump produces the same protein.

2. Protein synthesis is required to express the gene that produces the protein in the pump because with out it there would be no protein.

Notes on Scoring

This response earns no credit (0 points) because it states "…would maybe be the same since the pump produces the same protein." This indicates a lack of understanding. The gene would be the same for both cells. The second statements does not provide enough detail to describe how protein synthesis is required to express the gene for the Na^+-K^+ pump.

Sample Response: 0 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

Results from the scientists if they test both cells for the presence of a gene that produces this protein is most likely going to be different. Protein synthesis is required to express the gene that produces this protein because that is what it is, is protein and they have to test that.

Notes on Scoring

This response earns no credit (0 points) because it incorrectly states that "…a gene that produces this protein is most likely going to be different." The second statement does not describe how protein synthesis is required to express the gene for the Na^+-K^+ pump.

Sample Response: 0 points

Scientists are studying the protein in the Na^+-K^+ pump found in nerve and muscle cells from a pig. They are interested in learning how DNA and proteins from two different types of cells from the same organism compare to one another.

Describe the results scientists should see if they test both cells for the presence of the gene that produces this protein in the Na^+-K^+ pump.

Describe how protein synthesis is required to express the gene that produces this protein in the Na^+-K^+ pump.

Type your answer in the space provided.

Scientists should see that both cells have the protein Na+-K+.
Protein synthesis is required to express the gene that produces this protein in the Na+-K+ pump because the protein synthesis exposes the gene, whihch shows that it produces the protein.

Notes on Scoring

This response earns no credit (0 points) because it is not responsive to the task. It does not compare the presence of the gene that produces the Na^+-K^+ pump. The second statement does not provide enough detail to describe how protein synthesis is required to express the gene for the Na^+-K^+ pump.

Biology
Practice Test

Question 3

Question and Scoring Guidelines

Question 3

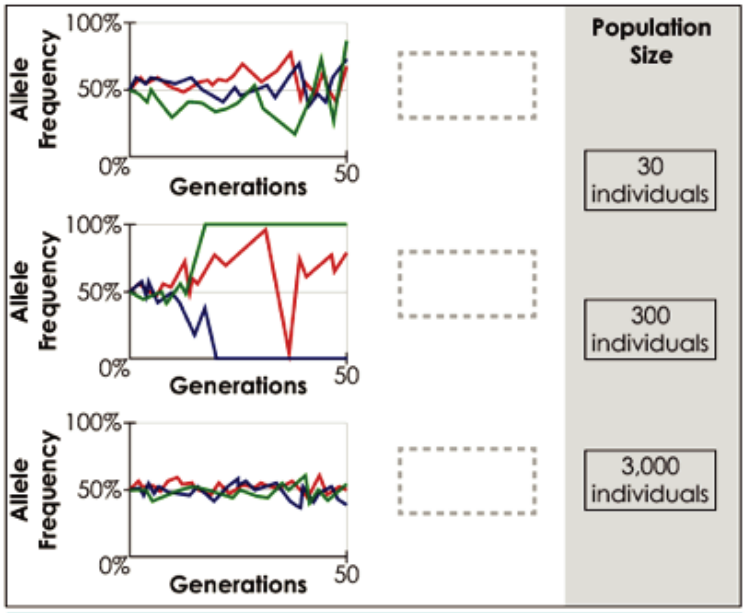
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "300 individuals" in the top box

  AND

- "30 individuals" in the middle box

  AND

- "3,000 individuals" in the bottom box (1 point)

  AND

- The middle graph selected (1 point).

Alignment

Topic
Evolution

Subtopic
Mechanisms

Content Elaboration
Biological evolution explains the natural origins for the diversity of life. Emphasis shifts from thinking in terms of selection of individuals with a particular trait to changing proportions of a trait in populations. The study of evolution must include Modern Synthesis, the unification of genetics and evolution and historical perspectives of evolutionary theory. The study of evolution must include gene flow, mutation, speciation, natural selection, genetic drift, sexual selection and Hardy Weinberg's law.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to interpret graphic data of an allele's change in frequency over many generations and correlate this to population size and genetic drift. In genetic drift, the change in the genetic composition of a population is due to chance or random events. In large populations, the effect of genetic drift is minimal but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently.

Biology
Practice Test

Question 3

Sample Responses

Sample Response: 2 points

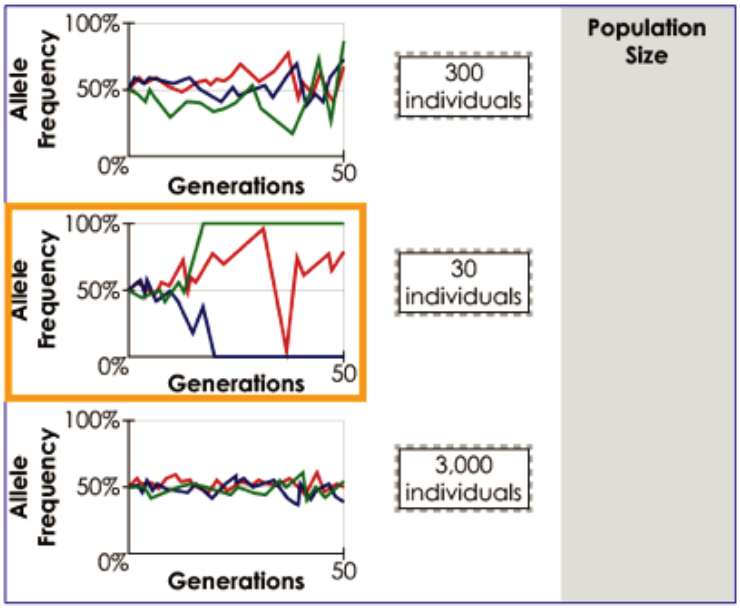
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Notes on Scoring

This response earns full credit (2 points). It correctly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response correctly selects the middle graph, which indicates the smallest population that shows the greatest impact on genetic variation from genetic drift.

Sample Response: 1 point

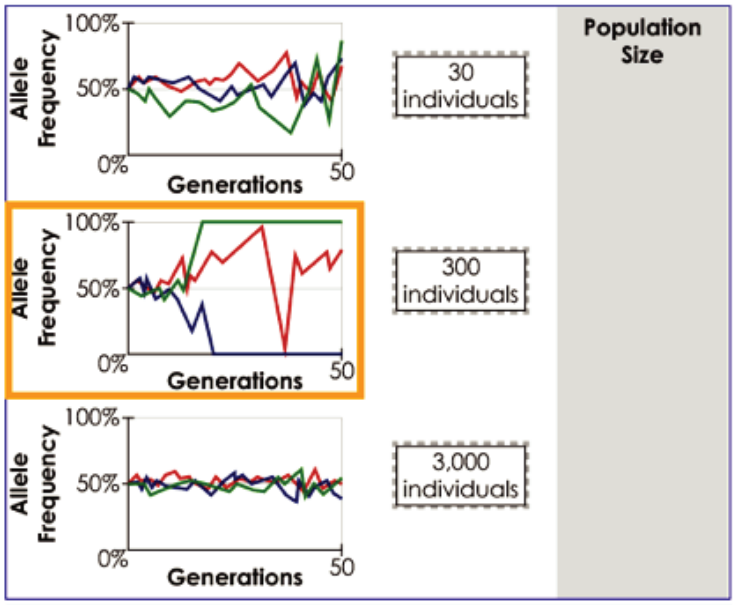
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Notes on Scoring

This response earns partial credit (1 point). It incorrectly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response correctly selects the middle graph, which indicates the population that shows the greatest impact on genetic variation from genetic drift.

Sample Response: 1 point

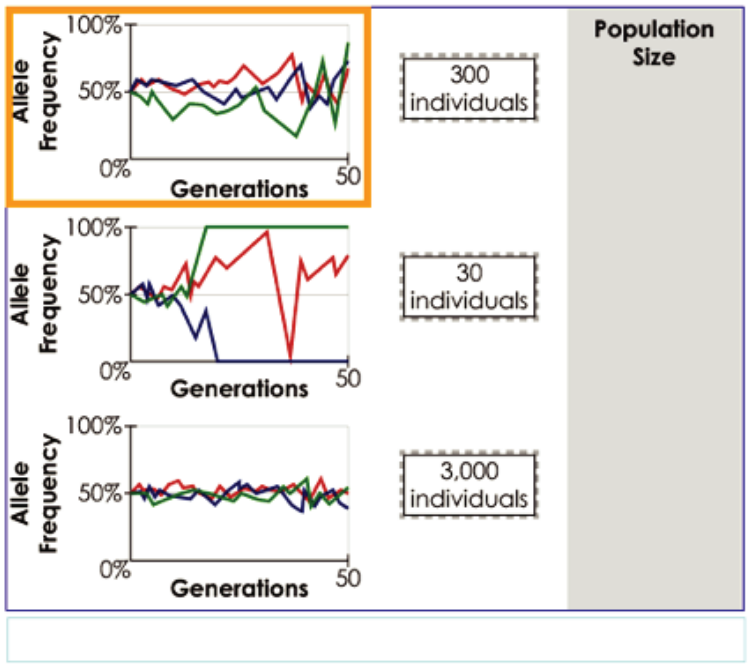
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Notes on Scoring

This response earns partial credit (1 point). It correctly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response incorrectly selects the top graph, which does not indicate the population that shows the greatest impact on genetic variation from genetic drift.

Sample Response: 0 points

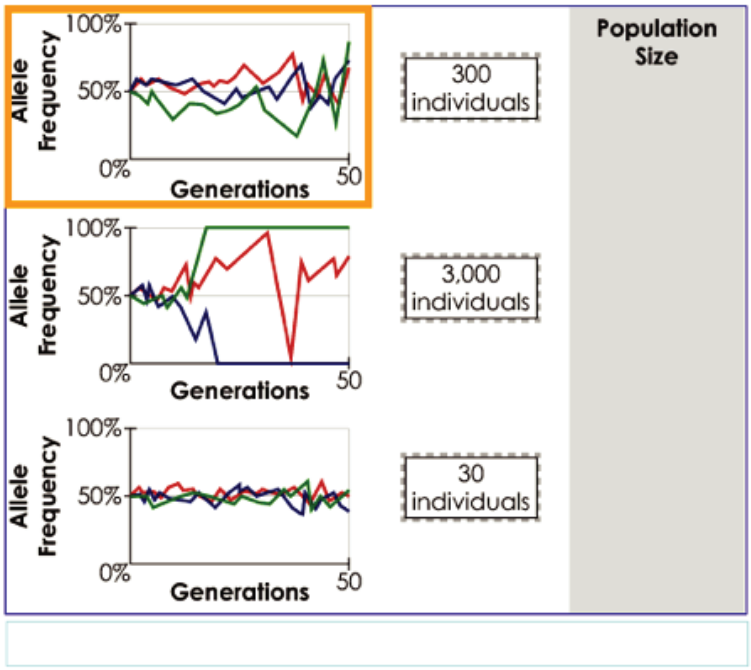
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Notes on Scoring

This response earns no credit (0 points). It incorrectly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response incorrectly selects the top graph, which does not indicate the population that shows the greatest impact on genetic variation from genetic drift.

Sample Response: 0 points

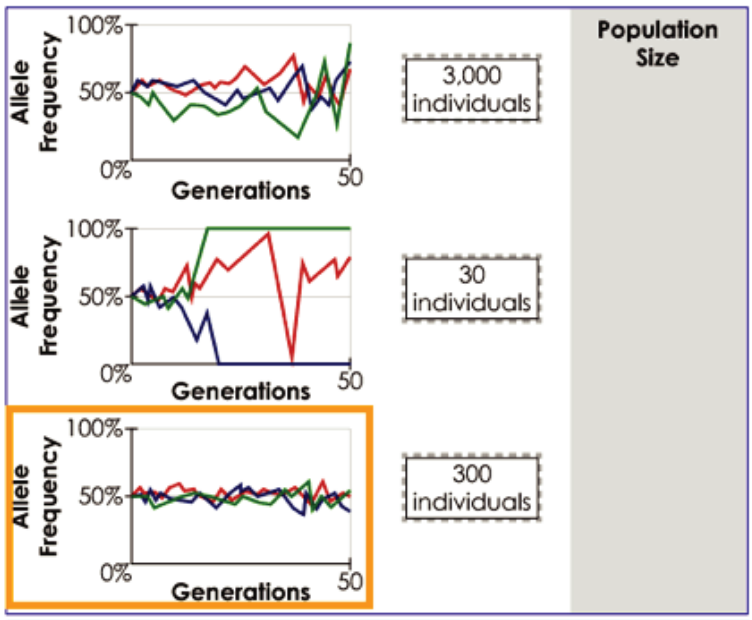
A computer program models the changing frequency of a single allele for three different population sizes. For each population, the program runs three simulations for fifty generations. The changes in allele frequency for each simulation are graphed as shown.

Determine which allele frequency graph matches which population size.

A. Move the correct population size labels into the blank boxes next to the appropriate graphs.

B. Click on the graph that shows the greatest impact on genetic variation from genetic drift.

- Use only **one** label in each blank box.



Notes on Scoring

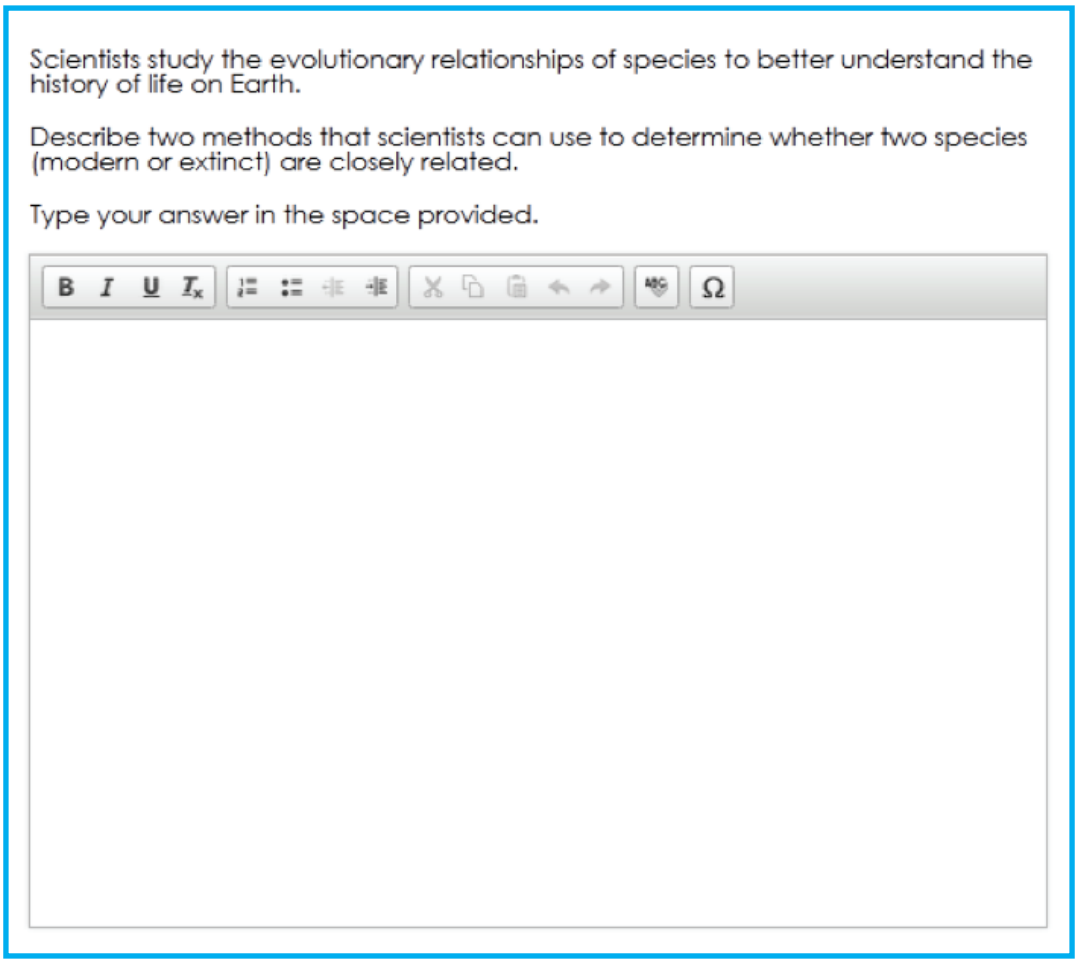
This response earns no credit (0 points). It incorrectly matches the population size with the proper allele frequency graph. In large populations, the effect of genetic drift is minimal, but it has a greater impact in small populations. In a small population, genetic drift can result in some alleles occurring more frequently while others occur less frequently. The response incorrectly selects the bottom graph, which does not indicate the population that shows the greatest impact on genetic variation from genetic drift.

Biology
Practice Test

Question 4

Question and Scoring Guidelines

Question 4



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

Score Point	Description
2 points	The response provides a complete interpretation and/or correct solution. It demonstrates a thorough understanding of the concept or task. It indicates logical reasoning and conclusions. It is accurate, relevant and complete. The response correctly • Describes two methods scientists can use to determine whether two species (modern or extinct) are closely related.
1 point	The response provides evidence of a partial interpretation and/or solution process. It demonstrates an incomplete understanding of the concept or task. It contains minor flaws in reasoning. It neglects to address some aspect of the concept or task. The response correctly • Describes one method scientists can use to determine whether two species (modern or extinct) are closely related.
0 points	The response does not meet the criteria required to earn one point. The response indicates inadequate or no understanding of the task and/or the idea or concept needed to answer the item. The response may provide an incorrect solution/response.

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.

Content Elaboration
Classification systems are frameworks developed by scientists for describing the diversity of organisms, indicating the degree of relatedness between organisms. Recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons. Both morphological comparisons and molecular evidence must be used to describe biodiversity.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to recall the different ways that scientists are able to determine the evolutionary relationships among diverse species. Both morphological comparisons and molecular evidence (modern or extinct) can be used to compare the degree of relatedness among organisms.

Biology
Practice Test

Question 4

Sample Responses

Sample Response: 2 points

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

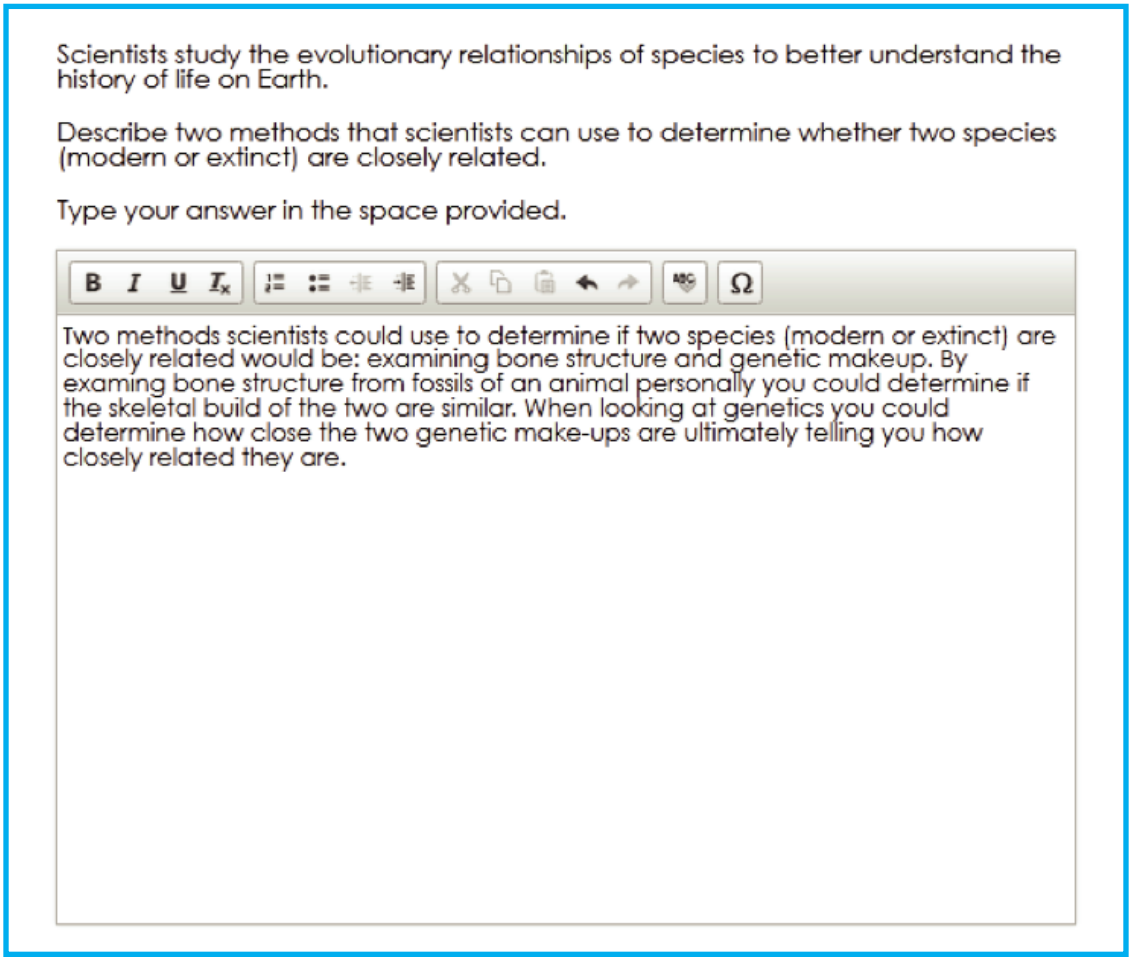
Type your answer in the space provided.

One method used by scientists to determine relation is the study of skeletal structure, or fossil remains. Related animals will often share many similar body structures, and usually have similar shape. Another method used is the direct comparison of DNA samples. The DNA of related species is often very similar, such as that of a human and a chimpanzee.

Notes on Scoring

This response earns full credit (2 points) because it correctly identifies two methods that scientists can use to determine the relatedness of two species: "...to determine relation is the study of skeletal structure, or fossil remains…Another method used is the direct comparison of DNA samples."

Sample Response: 2 points



Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

Two methods scientists could use to determine if two species (modern or extinct) are closely related would be: examining bone structure and genetic makeup. By examing bone structure from fossils of an animal personally you could determine if the skeletal build of the two are similar. When looking at genetics you could determine how close the two genetic make-ups are ultimately telling you how closely related they are.

Notes on Scoring

This response earns full credit (2 points) by identifying two methods for determining the relatedness of two species: "Two methods scientists could use to determine if two species (modern or extinct) are closely related would be: examining bone structure and genetic makeup."

Sample Response: 2 points

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

To decide whether two species are closely related, scientists can look at the skeletons of the species and at the species' DNA if available. Similar species have similar bone structure. Changes in bone structure over time can also be seen by the skeleton. For example, the tail cone on a human links us to monkeys. DNA can also be used if it can be found in the bones or something of extinct animals. Comparing strands of DNA can reveal the differences between species, but also illustrated the similarities if a large part of the DNA strands match.

Notes on Scoring

This response earns full credit (2 points) by identifying two methods for determining the relatedness of two species: "…scientists can look at the skeletons of the species and at the species' DNA if available."

Sample Response: 1 point

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

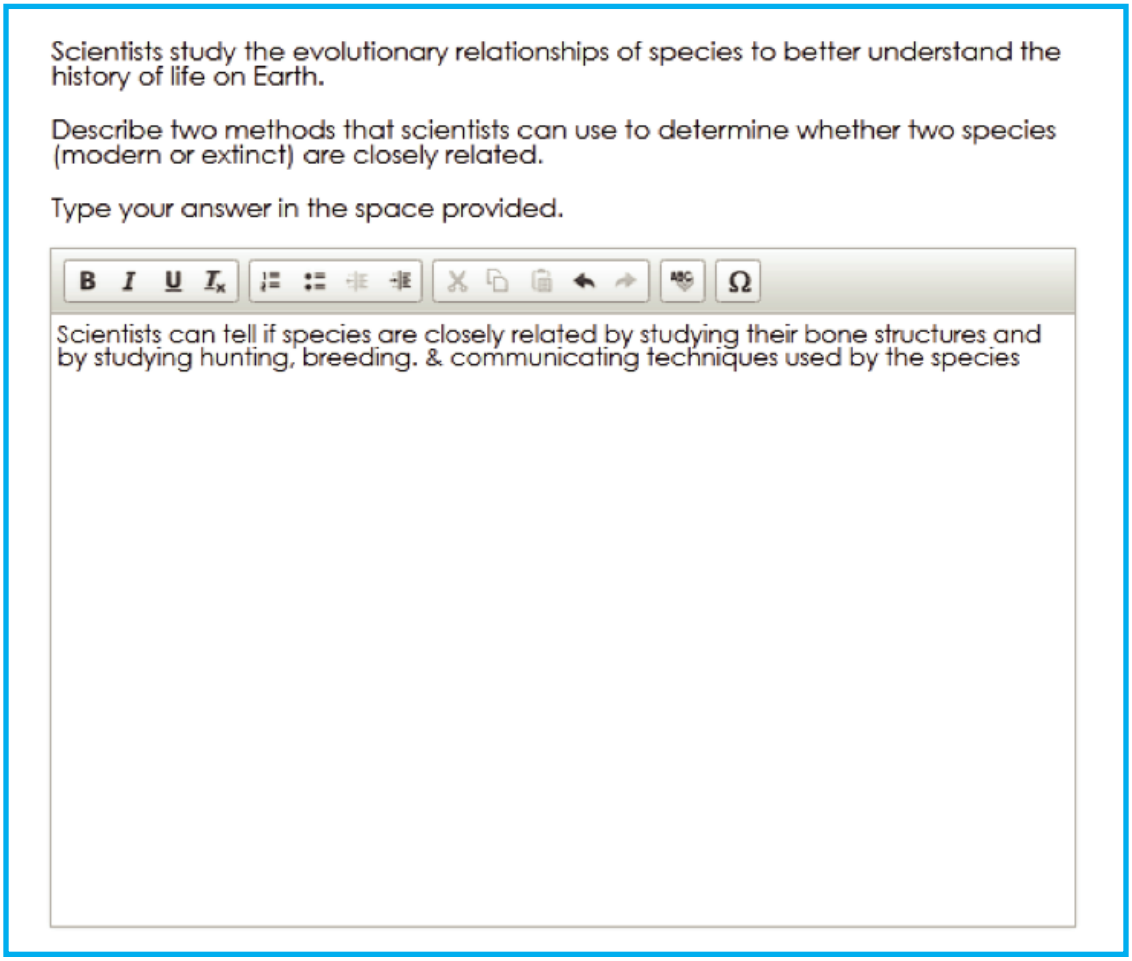
Type your answer in the space provided.

2 methods to determine whether 2 species are related is by using a dichotemy to split species up by characteristics. ALSO YOU COULD USE FOSSILS TO DETERMINE SIMILARITIES BETWEEN THE 2 SPECIES.

Notes on Scoring

This response earns partial credit (1 point) for identifying one method to determine the relatedness of two species "…YOU COULD USE FOSSILS TO DETERMINE SIMILARITIES BETWEEN THE 2 SPECIES." The first part of the response ("…by using a dichotemy to split species up by characteristics.") does not provide the criteria that the cladogram would be based upon and therefore receives no credit.

Sample Response: 1 point



Notes on Scoring

This response earns partial credit (1 point) by identifying one method for determining the relatedness of two species: "…by studying their bone structures… ." The study of behaviors, hunting, breeding and communicating is not used to determine evolutionary relationships between species.

Sample Response: 1 point

Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

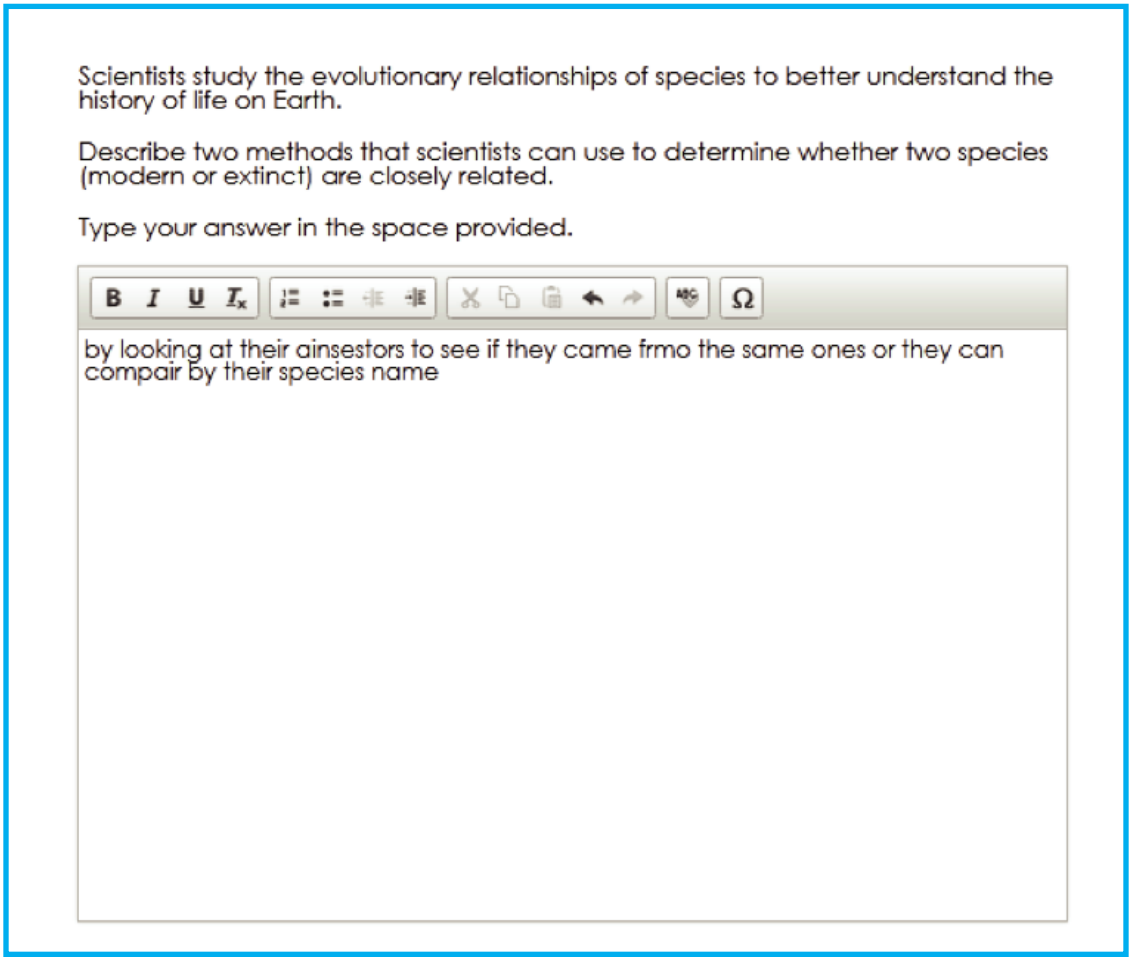
Type your answer in the space provided.

One method a scientist could use to determine how two species are related is they could look at extinct animals bone structure. If the bone structure is similar then the species were related. Anotehr method they could use is by looking at the teeth. Since what an animal eats determines how its teeth are shaped, then if the teeth are similar then they eat similar things and are related in that way. These are two methods scientists could use to determine whether two species are closely related.

Notes on Scoring

This response earns partial credit (1 point) by identifying one method for determining the relatedness of two species—bone structure. The remainder of the response provides additional information to support how bone structure is used.

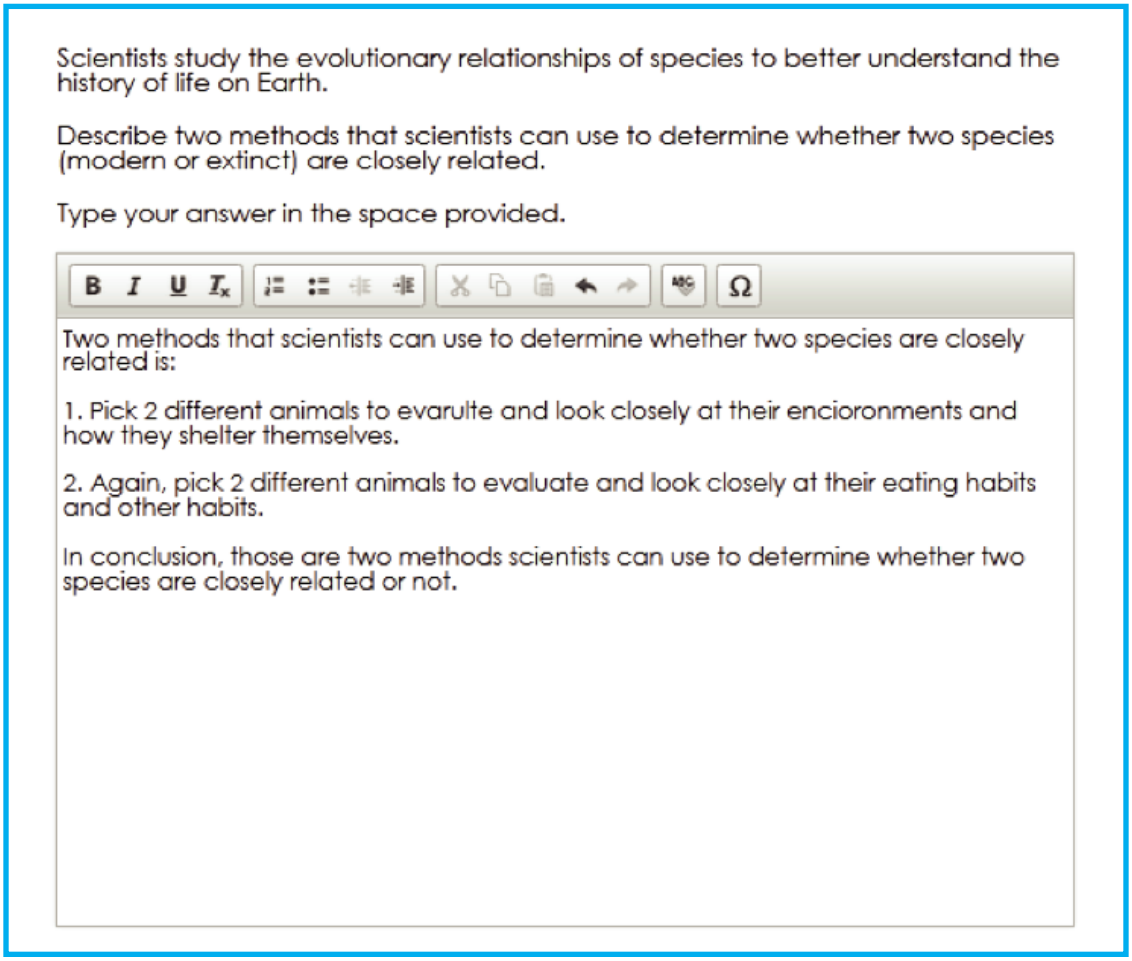
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because methods for determining the relatedness of two species are not provided. The response "by looking at their ainsestors to see if they came frmo the same ones…" is too vague to award credit.

Sample Response: 0 points


Scientists study the evolutionary relationships of species to better understand the history of life on Earth.

Describe two methods that scientists can use to determine whether two species (modern or extinct) are closely related.

Type your answer in the space provided.

Two methods that scientists can use to determine whether two species are closely related is:

1. Pick 2 different animals to evarulte and look closely at their encioronments and how they shelter themselves.

2. Again, pick 2 different animals to evaluate and look closely at their eating habits and other habits.

In conclusion, those are two methods scientists can use to determine whether two species are closely related or not.

Notes on Scoring

This response earns no credit (0 points) because methods for determining the relatedness of two species are not provided. Looking at the environment and eating habits are not used to determine evolutionary relationships between species.

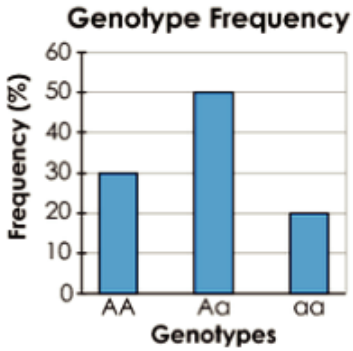
Biology
Practice Test

Question 5

Question and Scoring Guidelines

Question 5

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

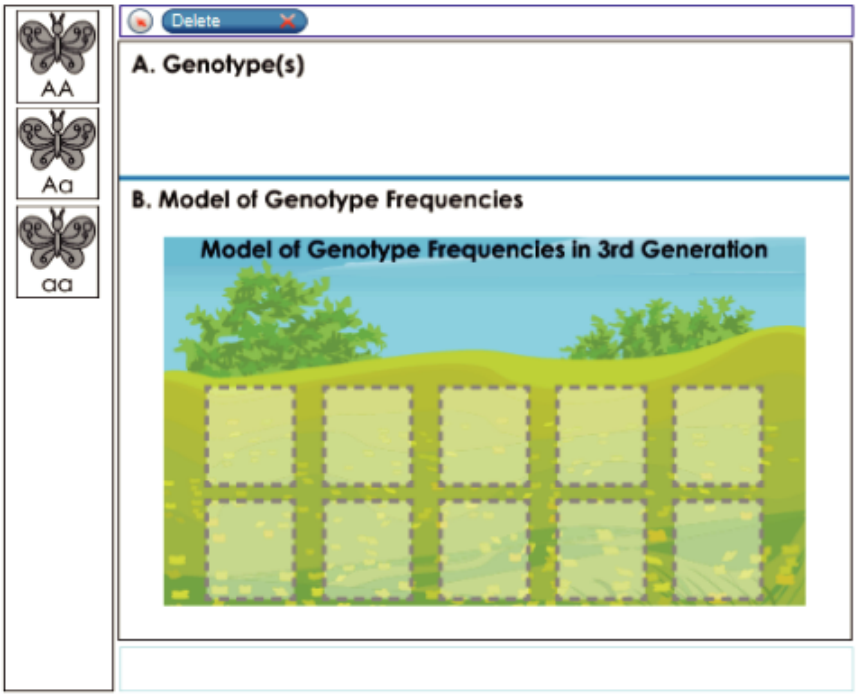


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.



Points Possible: 2

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes

- ONLY "aa" in Part A (1 point)

  AND

- Three or more "AA" butterflies

  AND

- At least one "Aa" butterfly

  AND

- One "aa" butterfly

  AND

- Ten total butterflies in Part B (1 point).

Alignment

Topic
Evolution

Subtopic
Diversity of Life

Content Elaboration
At the high school level, the term natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental effects upon the survival or reproduction of the individual with the trait.

Heritable characteristics influence how likely an organism is to survive and reproduce in a particular environment. When an environment changes, the survival value of inherited characteristics may change. This may or may not cause a change in species that inhabit the environment.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item

This item requires the student to create a model of allele frequencies in a butterfly population after the introduction of a predator. If the predator selects yellow butterflies, it removes the recessive alleles "aa" out of the population. Genotype "aa" has a higher rate of predation. The third generation model should have ten butterflies with only one genotype "aa," at least one "Aa" and a high number of "AA."

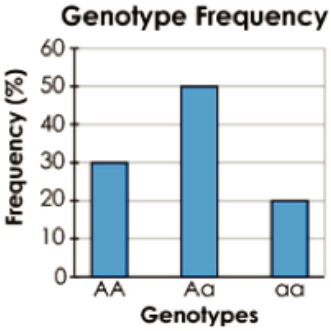
Biology
Practice Test

Question 5

Sample Responses

Sample Response: 2 points

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

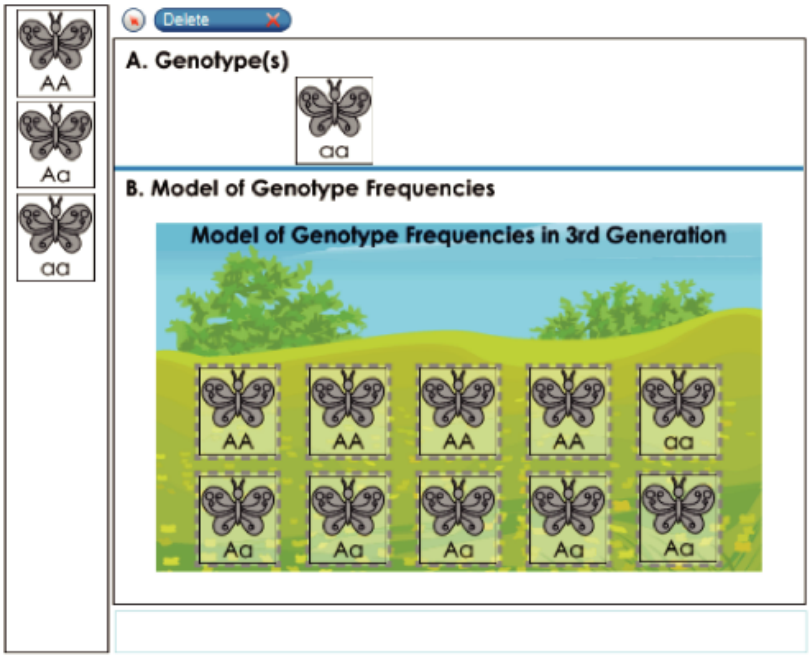


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

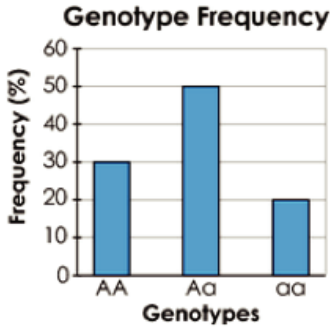


Notes on Scoring

This response earns full credit (2 points). It correctly identifies the genotype that will have the higher rate of predation ("aa") and builds an accurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(1), at least one "Aa"(5) and a high number of "AA"(4).

Sample Response: 2 points

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

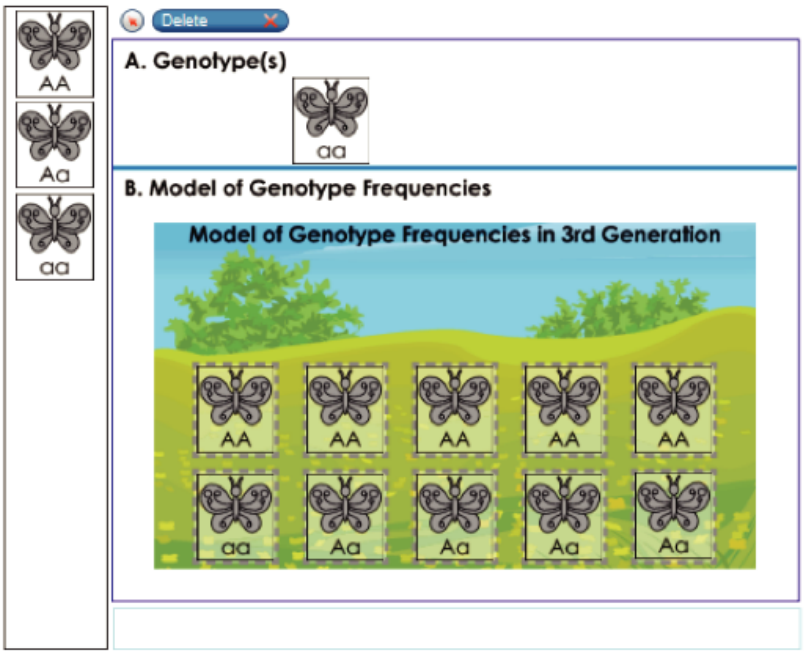


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

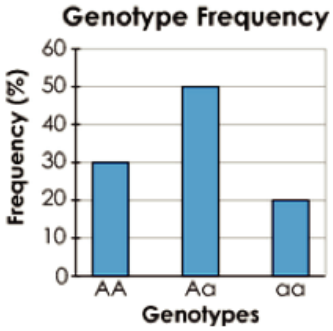


Notes on Scoring

This response earns full credit (2 points). It correctly identifies the genotype that will have the higher rate of predation ("aa") and builds an accurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(1), at least one "Aa"(4) and a high number of "AA"(5).

Sample Response: 1 point

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

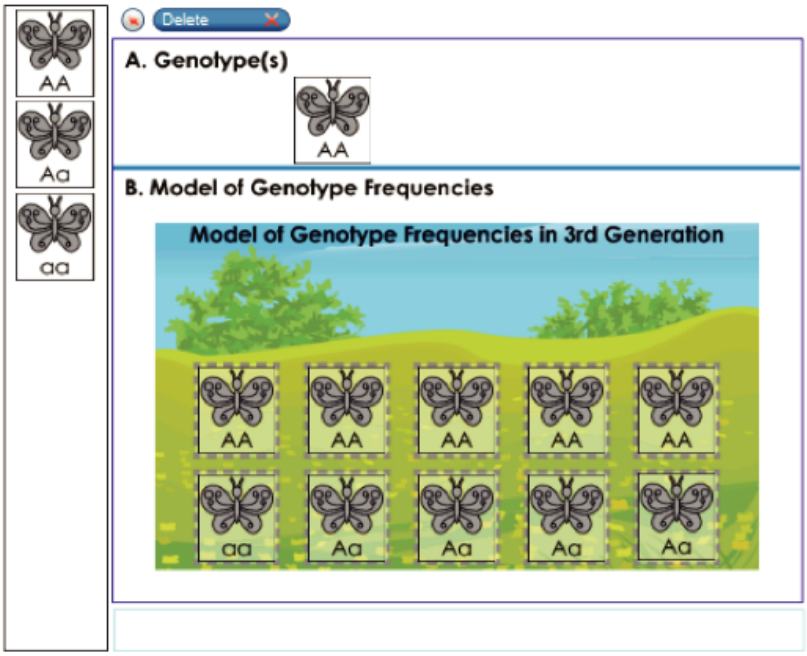


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

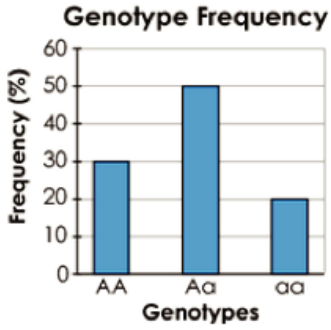


Notes on Scoring

This response earns partial credit (1 point). It incorrectly identifies the genotype that will have the higher rate of predation ("AA"). It should be "aa." This response earns credit for building an accurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(1), at least one "Aa"(4) and a high number of "AA"(5).

Sample Response: 1 point

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

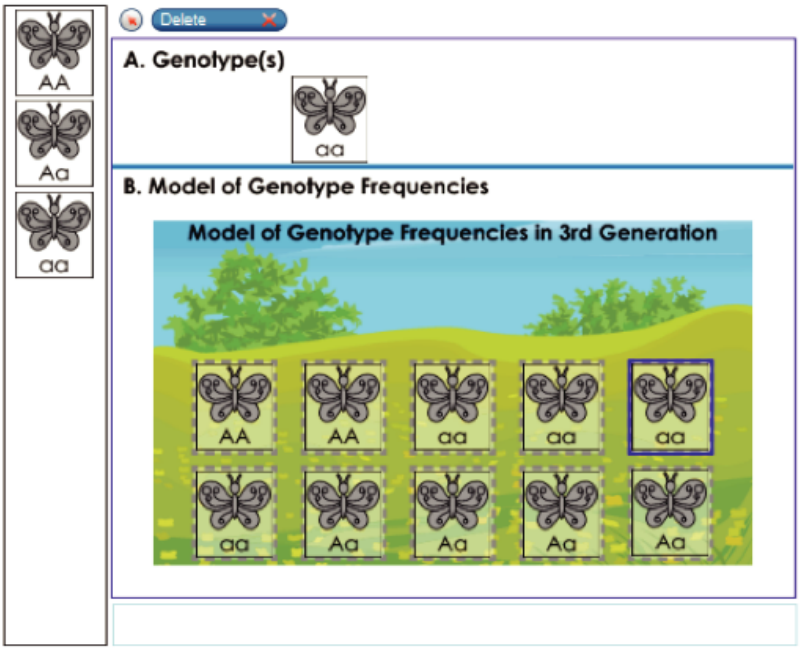


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

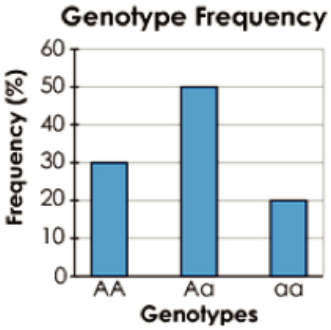


Notes on Scoring

This response earns partial credit (1 point). It correctly identifies the genotype that will have the higher rate of predation ("aa"). The response builds an inaccurate third generation model of genotypes, which should have ten butterflies with only one genotype "aa"(4), at least one "Aa"(4) and a high number of "AA"(2).

Sample Response: 1 point

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

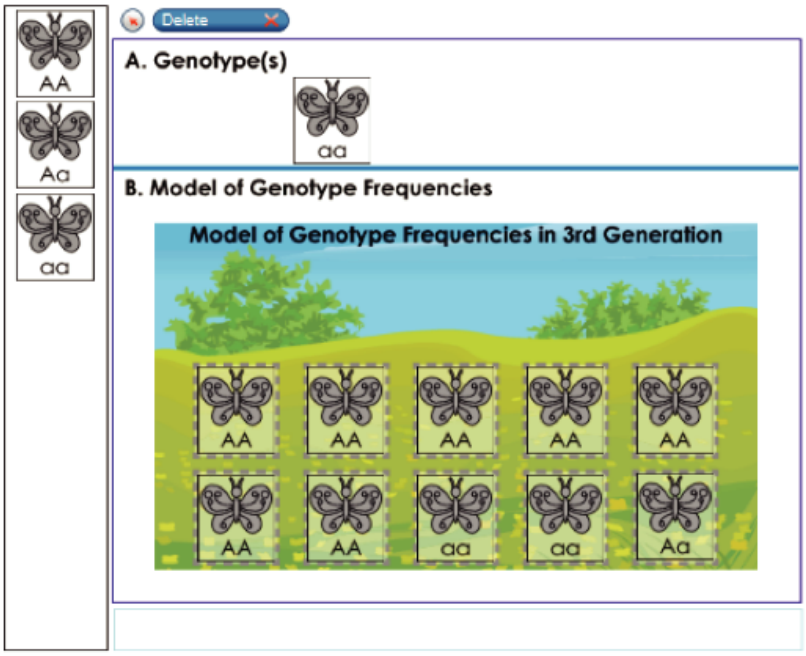


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

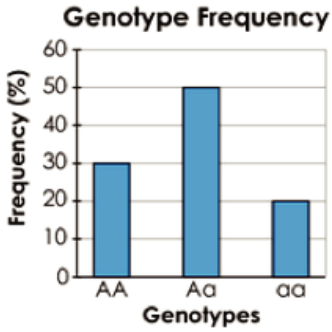


Notes on Scoring

This response earns partial credit (1 point). It correctly identifies the genotype that will have the higher rate of predation ("aa"). The response builds an inaccurate third generation model of genotypes, which should have ten butterflies with only one genotype, "aa"(2), at least one "Aa"(1) and a high number of "AA"(7). Having two "aa" keeps the population at 20%, which is in the data that was given for the starting population. If heavy predation occurs, that frequency is expected to drop.

Sample Response: 0 points

A species of butterfly, *Heliconius cydno alithea,* has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

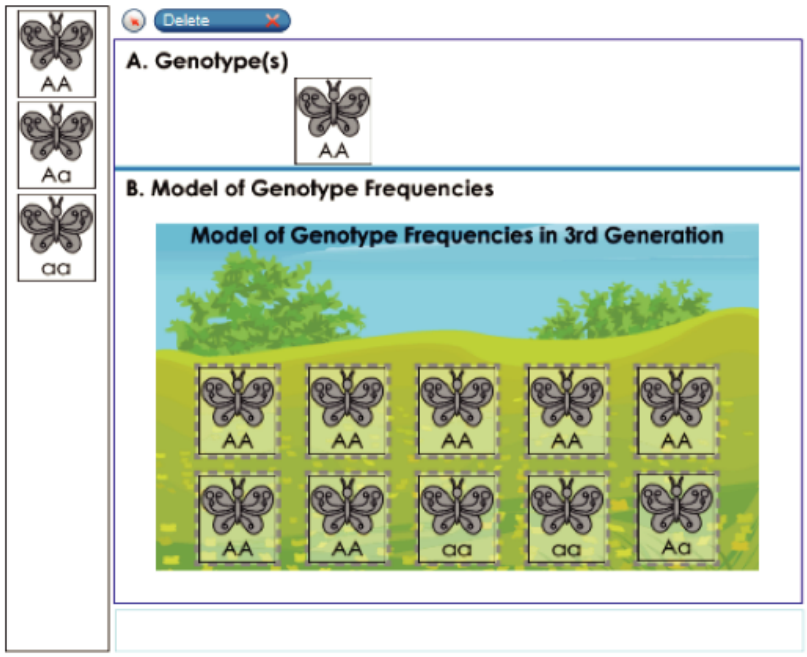


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.

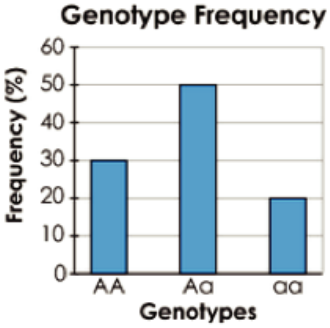


Notes on Scoring

This response earns no credit (0 points). It incorrectly identifies the genotype that will have the higher rate of predation ("AA"). The response builds an inaccurate third generation model of genotypes, which should have ten butterflies with only one genotype, "aa"(2), at least one "Aa"(1) and a high number of "AA"(6). Having two "aa" keeps the population at 20%, which is in the data that was given for the starting population. If heavy predation occurs, that frequency is expected to drop.

Sample Response: 0 points

A species of butterfly, *Heliconius cydno alithea*, has both white and yellow individuals. Its white allele is dominant and its yellow allele is recessive. The graph shows the genotype frequency for a generation of the butterfly.

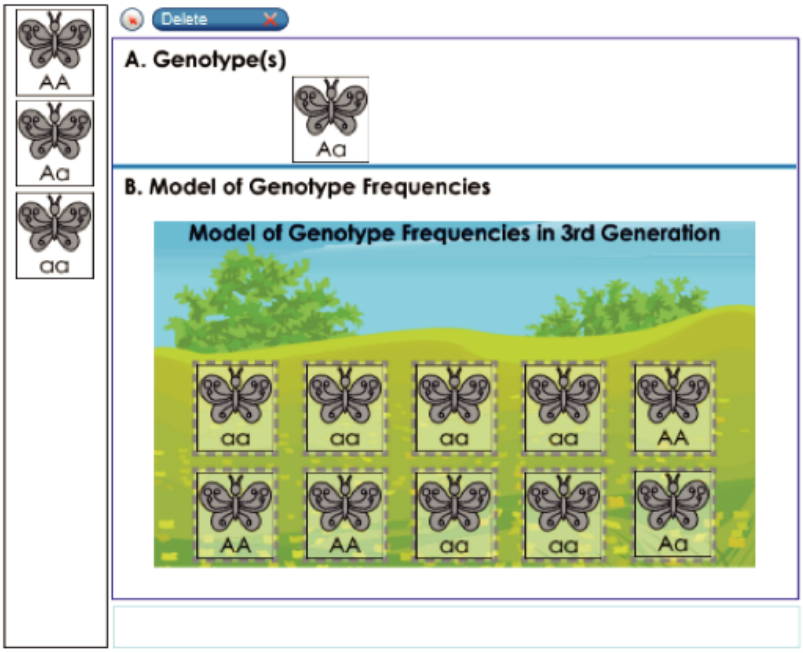


If a predator introduced to the butterfly habitat prefers the yellow trait, predict the genotype frequencies that will occur in the third generation.

A. Place the genotype(s) that will have higher rates of predation in the blank box.

B. Place ten butterflies in their habitat to create an approximate model of the genotype frequency in the new generation, assuming all genotypes are represented.

- There may be more than one correct answer.
- You may use each butterfly more than once.



Notes on Scoring

This response earns no credit (0 points). It incorrectly identifies the genotype that will have the higher rate of predation ("Aa"). The response builds an inaccurate third generation model of genotypes, which should have ten butterflies with only one genotype, "aa"(6), at least one "Aa"(1) and a high number of "AA"(3). Having six individuals with "aa" increases their number in the population, which is opposite of what is expected if heavy predation occurs.

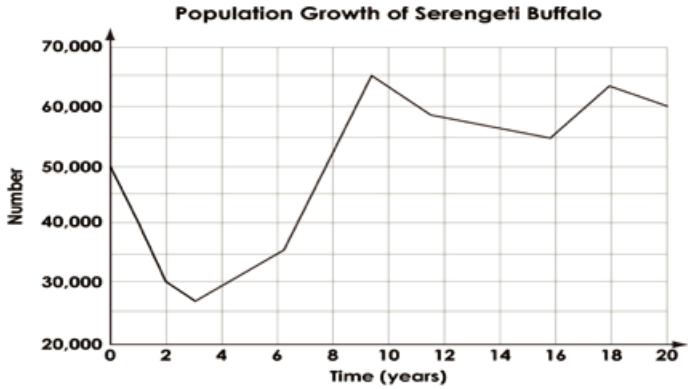
Biology
Practice Test

Question 6

Question and Scoring Guidelines

Question 6

The graph shows how a Serengeti buffalo population changed over a period of years. During this time period, the buffalo were affected by the rinderpest virus, a debilitating disease with a high mortality rate. However, within five years, the virus was eliminated.



What was the ecosystem's carrying capacity for buffalo, based on the graph, once rinderpest was eliminated?

Ⓐ 35,000 buffalo
Ⓑ 55,000 buffalo
Ⓒ 60,000 buffalo
Ⓓ 65,000 buffalo

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. The buffalo population exceeds 30,000 individuals over time. It levels off at about 60,000, which indicates the carrying capacity.

Rationale for Option B: This is incorrect. The buffalo population exceeds 55,000 individuals over time. It levels off at about 60,000, which indicates the carrying capacity.

Rationale for Option C: **Key** – The buffalo population grows to slightly exceed 60,000 individuals and then falls again as it stabilizes around its carrying capacity.

Rationale for Option D: This is incorrect. The buffalo population reaches 65,000 individuals but immediately declines towards 60,000 individuals.

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Ecosystems

Content Elaboration
Some ecosystems can be reasonably persistent over hundreds or thousands of years. Like many complex systems, ecosystems tend to have cyclic fluctuations around a state of rough equilibrium. In the long run, however, ecosystems always change as geological or biological conditions vary. Misconceptions about population growth capacity, interspecies and intra-species competition for resources, and what occurs when a species immigrates to or emigrates from ecosystems are included in this topic.

Carrying capacity is defined as the population equilibrium sized when births and deaths are equal; hence population growth rate = zero.

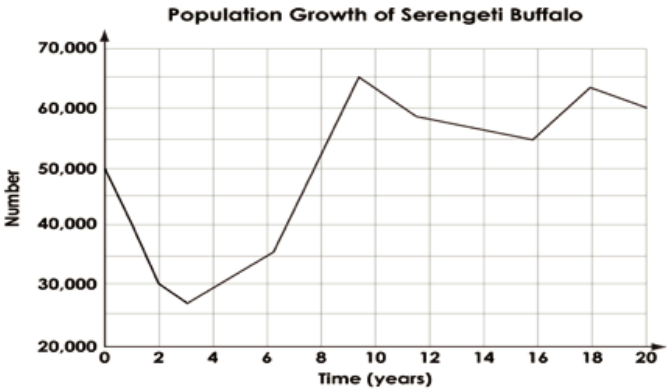
Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires students to analyze a population growth data for Serengeti buffalo to determine how the population was impacted when a rinderpest virus was introduced and exited from this population. From this graph, students are asked to determine the buffalo's carrying capacity when the virus was eliminated.

Sample Response: 1 point

The graph shows how a Serengeti buffalo population changed over a period of years. During this time period, the buffalo were affected by the rinderpest virus, a debilitating disease with a high mortality rate. However, within five years, the virus was eliminated.



What was the ecosystem's carrying capacity for buffalo, based on the graph, once rinderpest was eliminated?

- Ⓐ 35,000 buffalo
- Ⓑ 55,000 buffalo
- ● 60,000 buffalo
- Ⓓ 65,000 buffalo

Biology
Practice Test

Question 7

Question and Scoring Guidelines

Question 7

The table compares structures found in several groups of photosynthetic organisms. The presence of a structure is symbolized by a (+) symbol, while the absence of a structure is symbolized by a (-) symbol.

Using the data in the table, determine where on the cladogram some of the structures evolved.

Place a structure number label into each blank box.

- Place only **one** number label into each blank box.
- You do **not** need to use all the number labels.

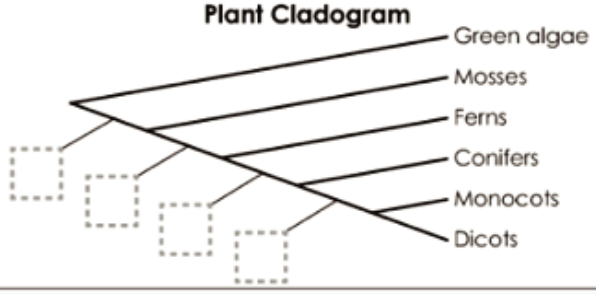
1
2
3
4
5

Delete

Structures of Photosynthetic Organisms

	Green Algae	Moss	Fern	Conifer	Monocot	Dicot
1. Chloroplasts	+	+	+	+	+	+
2. Cuticle	–	+	+	+	+	+
3. Flowers	–	–	–	–	+	+
4. Seeds	–	–	–	+	+	+
5. Vascular Tissue	–	–	+	+	+	+

Plant Cladogram



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Labels placed from Left to Right: “2,” “5,” “4,” “3” (1 point).

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.

Content Elaboration
Classification systems are frameworks developed by scientists for describing the diversity of organisms, indicating the degree of relatedness between organisms. Recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons. Both morphological comparisons and molecular evidence must be used to describe biodiversity (cladograms can be used to address this).

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

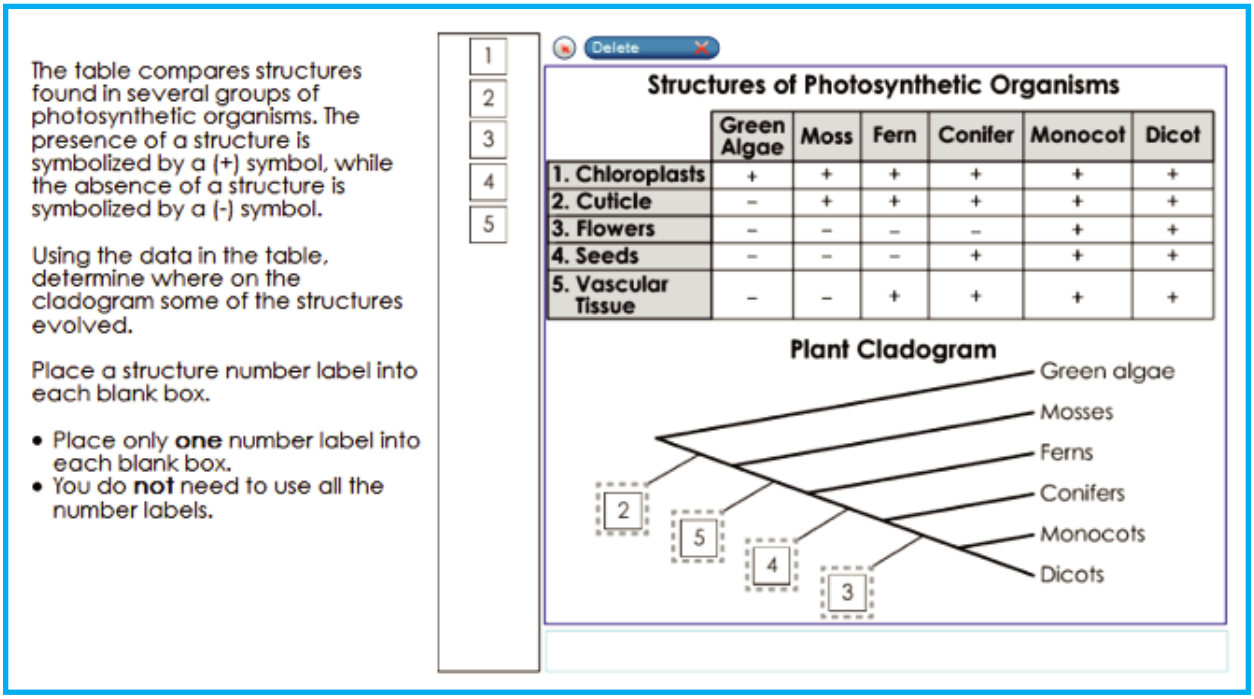
Explanation of the Item
This item requires the students to complete a cladogram based on anatomic comparisons among organisms. Given a table of structures found in photosynthetic organisms, students determine when the structure evolved based on the presence or absence of a structure. The sequence of the Plant Cladogram diagram should be 2, 5, 4, 3. The cuticle appeared in a group of organisms after green algae. Vascular tissue appeared in a group of organisms after mosses. Seeds appeared in a group of organisms after ferns, and flowers appeared in a group of organisms after conifers.

Biology
Practice Test

Question 7

Sample Responses

Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because it indicates the correct sequence of numbers (2, 5, 4, 3), indicating where on the cladogram some of the structures evolved. The cuticle appeared in a group of organisms after green algae. Vascular tissue appeared in a group of organisms after mosses. Seeds appeared in a group of organisms after ferns, and flowers appeared in a group of organisms after conifers.

Sample Response: 0 points

The table compares structures found in several groups of photosynthetic organisms. The presence of a structure is symbolized by a (+) symbol, while the absence of a structure is symbolized by a (-) symbol.

Using the data in the table, determine where on the cladogram some of the structures evolved.

Place a structure number label into each blank box.

- Place only **one** number label into each blank box.
- You do **not** need to use all the number labels.

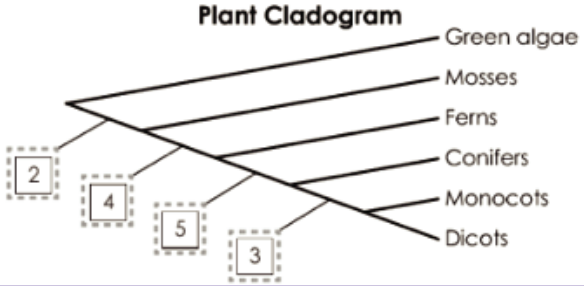
1
2
3
4
5

Delete

Structures of Photosynthetic Organisms

	Green Algae	Moss	Fern	Conifer	Monocot	Dicot
1. Chloroplasts	+	+	+	+	+	+
2. Cuticle	–	+	+	+	+	+
3. Flowers	–	–	–	–	+	+
4. Seeds	–	–	–	+	+	+
5. Vascular Tissue	–	–	+	+	+	+

Plant Cladogram



Notes on Scoring

This response earns no credit (0 points) because of the incorrect sequence of numbers (2, 4, 5, 3). The correct response sequence indicating where on the cladogram some of the structures evolved should have been 2, 5, 4, 3.

Sample Response: 0 points

The table compares structures found in several groups of photosynthetic organisms. The presence of a structure is symbolized by a (+) symbol, while the absence of a structure is symbolized by a (-) symbol.

Using the data in the table, determine where on the cladogram some of the structures evolved.

Place a structure number label into each blank box.

- Place only **one** number label into each blank box.
- You do **not** need to use all the number labels.

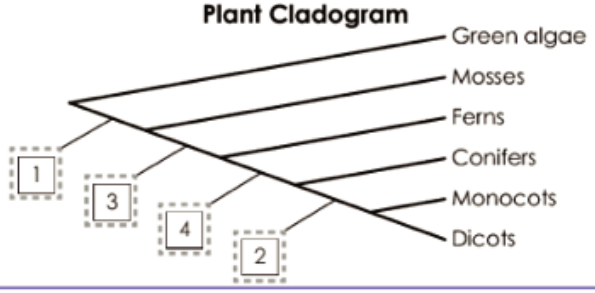
1
2
3
4
5

Delete

Structures of Photosynthetic Organisms

	Green Algae	Moss	Fern	Conifer	Monocot	Dicot
1. Chloroplasts	+	+	+	+	+	+
2. Cuticle	–	+	+	+	+	+
3. Flowers	–	–	–	–	+	+
4. Seeds	–	–	–	+	+	+
5. Vascular Tissue	–	–	+	+	+	+

Plant Cladogram



Notes on Scoring

This response earns no credit (0 points) because of the incorrect sequence of numbers (1, 3, 4, 2). The correct response sequence indicating where on the cladogram some of the structures evolved should have been 2, 5, 4, 3.

Biology
Practice Test

Question 8

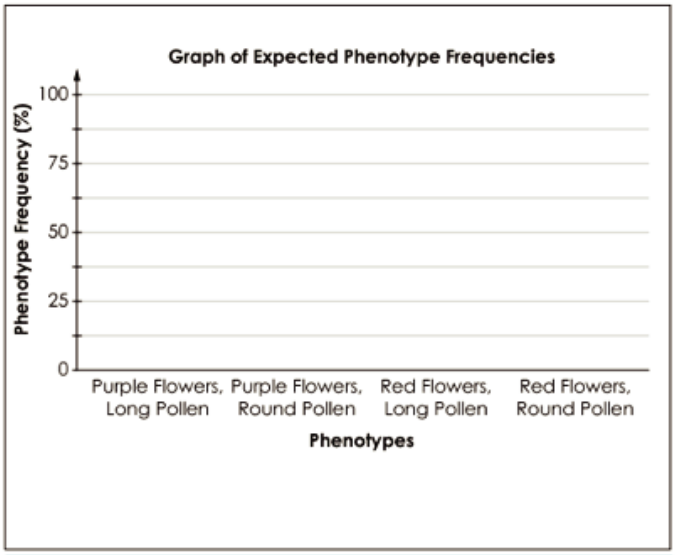
Question and Scoring Guidelines

Question 8

Students conduct an experiment to test whether or not the trait for pollen shape and the trait for flower color are next to each other on the same chromosome in pea plants. They cross two plants that are known to be heterozygous for both traits to produce offspring.

Long pollen shape (L) is dominant over round pollen shape (l). Purple flower color (P) is dominant over red flower color (p).

Click on the value of each phenotype frequency on the graph that would be expected if the traits are linked and the dominant traits are next to each other on the same chromosome for both plants.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "75" selected for Purple Flowers, Long Pollen;

  AND

- Nothing or "0" selected for Purple Flowers, Round Pollen;

  AND

- Nothing or "0" selected for Red Flowers, Long Pollen;

  AND

- "25" selected for Red Flowers, Round Pollen (1 point).

Alignment

Topic
Heredity

Subtopic
Genetic Mechanisms and Inheritance

Content Elaboration
In high school, genetic mechanisms (both classical and modern), including incomplete dominance, sex-linked traits, goodness of fit test (Chi-square) and dihybrid crosses, are investigated through real-world examples. Dihybrid crosses can be used to explore linkage groups.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to determine the outcome of a dihybrid cross when the traits may be linked. If two traits are linked on the same homologous chromosome, when crossing over occurs during meiosis, the alleles do not segregate. In this case, the two dominant traits are linked on one chromosome, and the two recessive alleles are linked on the other. The outcome of the cross is expected to be 75% purple flowers and long pollen and 25% red flowers and round pollen. If the alleles were not linked we would expect a 9:3:3:1 ratio.

Biology
Practice Test

Question 8

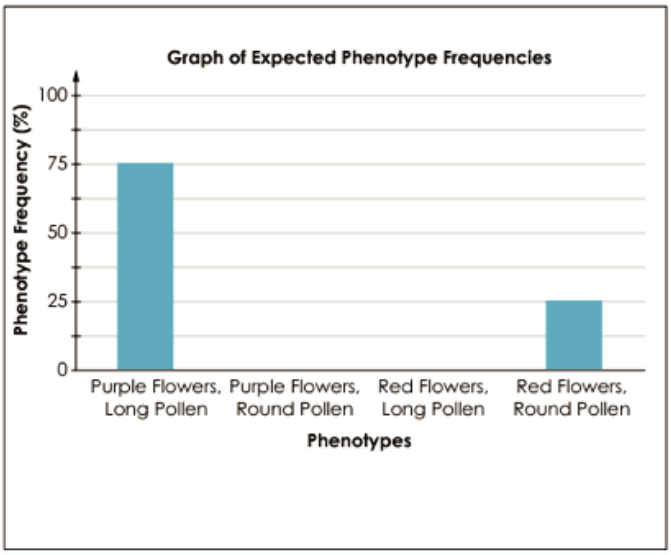
Sample Responses

Sample Response: 1 point

Students conduct an experiment to test whether or not the trait for pollen shape and the trait for flower color are next to each other on the same chromosome in pea plants. They cross two plants that are known to be heterozygous for both traits to produce offspring.

Long pollen shape (L) is dominant over round pollen shape (l). Purple flower color (P) is dominant over red flower color (p).

Click on the value of each phenotype frequency on the graph that would be expected if the traits are linked and the dominant traits are next to each other on the same chromosome for both plants.



Notes on Scoring

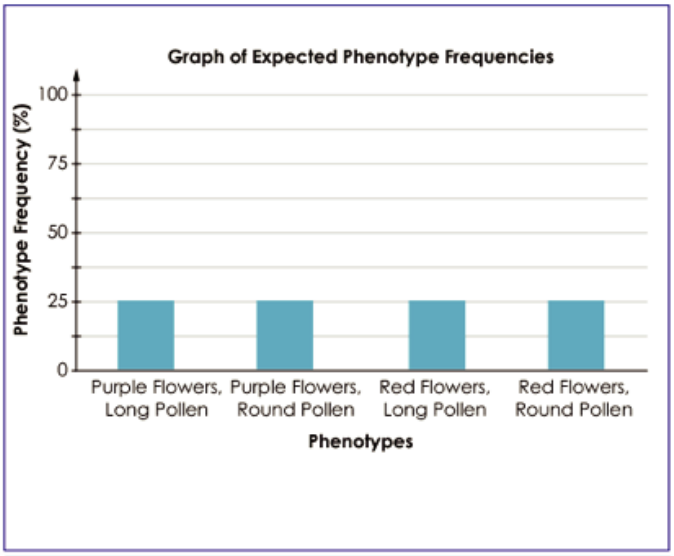
This response earns full credit (1 point) because it correctly indicates the value of each phenotype frequency on the graph: "75" for Purple Flowers, Long Pollen and "25" for Red Flowers, Round Pollen. The response also indicates "0" for Purple Flowers, Round Pollen and "0" for Red Flowers, Long Pollen.

Sample Response: 0 points

Students conduct an experiment to test whether or not the trait for pollen shape and the trait for flower color are next to each other on the same chromosome in pea plants. They cross two plants that are known to be heterozygous for both traits to produce offspring.

Long pollen shape (L) is dominant over round pollen shape (l). Purple flower color (P) is dominant over red flower color (p).

Click on the value of each phenotype frequency on the graph that would be expected if the traits are linked and the dominant traits are next to each other on the same chromosome for both plants.



Notes on Scoring

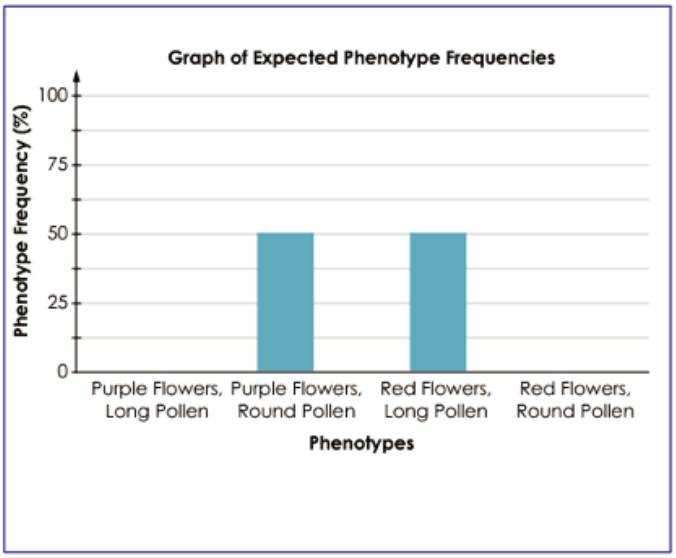
This response earns no credit (0 points) because it incorrectly indicates the value of each phenotype frequency on the graph: "25" for Purple Flowers, Long Pollen; "25" for Purple Flowers, Round Pollen; "25" for Red Flowers, Long Pollen; and "25" for Red Flowers, Round Pollen. The correct value of each phenotype frequency on the graph is "75" for Purple Flowers, Long Pollen; "25" for Red Flowers, Round Pollen; "0" for Purple Flowers, Round Pollen; and "0" for Red Flowers, Long Pollen.

Sample Response: 0 points

Students conduct an experiment to test whether or not the trait for pollen shape and the trait for flower color are next to each other on the same chromosome in pea plants. They cross two plants that are known to be heterozygous for both traits to produce offspring.

Long pollen shape (L) is dominant over round pollen shape (l). Purple flower color (P) is dominant over red flower color (p).

Click on the value of each phenotype frequency on the graph that would be expected if the traits are linked and the dominant traits are next to each other on the same chromosome for both plants.



Notes on Scoring

This response earns no credit (0 points) because it incorrectly indicates the value of each phenotype frequency on the graph. The correct value of each phenotype frequency on the graph is "75" for Purple Flowers, Long Pollen; "25" for Red Flowers, Round Pollen; "0" for Purple Flowers, Round Pollen; and "0" for Red Flowers, Long Pollen.

Biology
Practice Test

Question 9

Question and Scoring Guidelines

Question 9

A scientist isolates a number of non-photosynthetic prokaryotes.

Which structure would be found in these cells?

Ⓐ cell walls

Ⓑ chloroplast

Ⓒ golgi

Ⓓ nucleus

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – Bacteria cells contain cell walls.

Rationale for Option B: This is incorrect. Only photosynthetic eukaryotes contain chloroplasts.

Rationale for Option C: This is incorrect. Only photosynthetic eukaryotes contain chloroplasts.

Rationale for Option D: This is incorrect. Only eukaryotes contain nuclei.

Alignment

Topic
Cells

Subtopic
Cell Structure and Function

Content Elaboration
The cell is a system that conducts a variety of functions associated with life. Details of cellular processes such as photosynthesis, chemosynthesis, cellular respiration, cell division and differentiation are studied at this grade level.

Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape. Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to know the structural features of prokaryotic cells. Prokaryotic cells have cell walls. Chloroplasts are only found in photosynthetic cells. Golgi and nuclei are found in eukaryotic cells.

Sample Response: 1 point

A scientist isolates a number of non-photosynthetic prokaryotes.

Which structure would be found in these cells?

- ● cell walls
- Ⓑ chloroplast
- Ⓒ golgi
- Ⓓ nucleus

Biology
Practice Test

Question 10

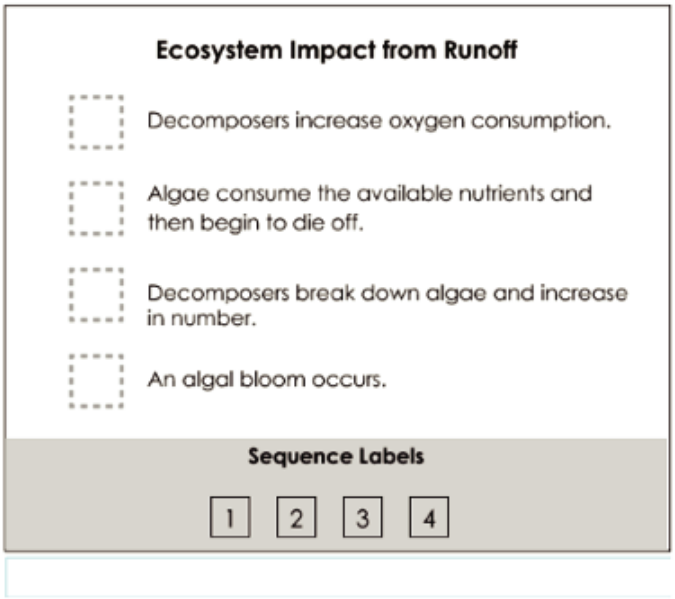
Question and Scoring Guidelines

Question 10

Oxygen depletion, also known as hypoxia, is one result of runoff from over-fertilized lawns or farmland. After heavy rains, nutrient-rich water enters the local aquatic environment, causing a series of events to occur within the ecosystem.

Some events caused by nutrient-rich runoff entering a lake ecosystem are shown.

Move the sequence labels into the blank boxes to sequence the correct order of these events.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "4" placed next to "Decomposers increase oxygen consumption";

  AND

- "2" placed next to "Algae consume the available nutrients and the begin to die off";

  AND

- "3" placed next to "Decomposers break down algae and increase in number";

  AND

- "1" placed next to "An algal bloom occurs (1 point)."

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Ecosystems

Content Elaboration
Organisms transform energy (flow of energy) and matter (cycles of matter) as they survive and reproduce. The cycling of matter and flow of energy occurs at all levels of biological organization, from molecules to ecosystems. At the high school level, the concept of energy flow as unidirectional in ecosystems is explored.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to analyze an ecological scenario and determine the responses of several classes of organisms. In this scenario, an algal bloom occurs and consumes the available nutrients. The algae begin to die off, and the decomposers break down algae and increase in number, which causes them to consume more oxygen.

Biology
Practice Test

Question 10

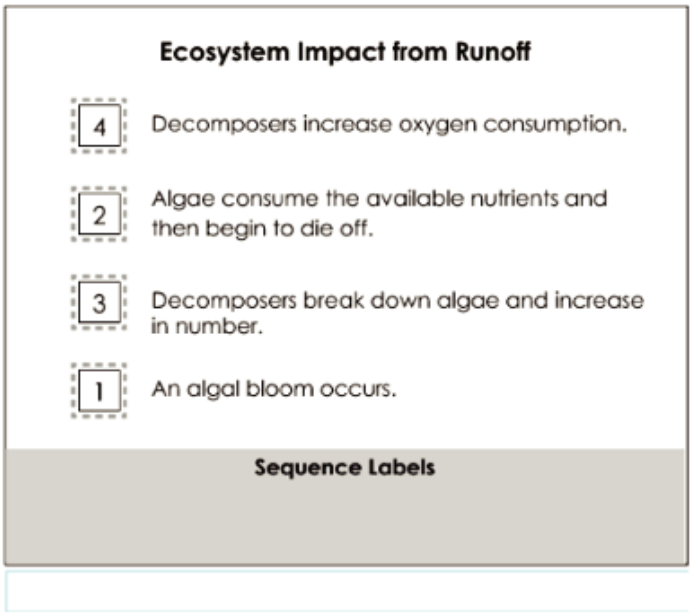
Sample Responses

Sample Response: 1 point

Oxygen depletion, also known as hypoxia, is one result of runoff from over-fertilized lawns or farmland. After heavy rains, nutrient-rich water enters the local aquatic environment, causing a series of events to occur within the ecosystem.

Some events caused by nutrient-rich runoff entering a lake ecosystem are shown.

Move the sequence labels into the blank boxes to sequence the correct order of these events.



Notes on Scoring

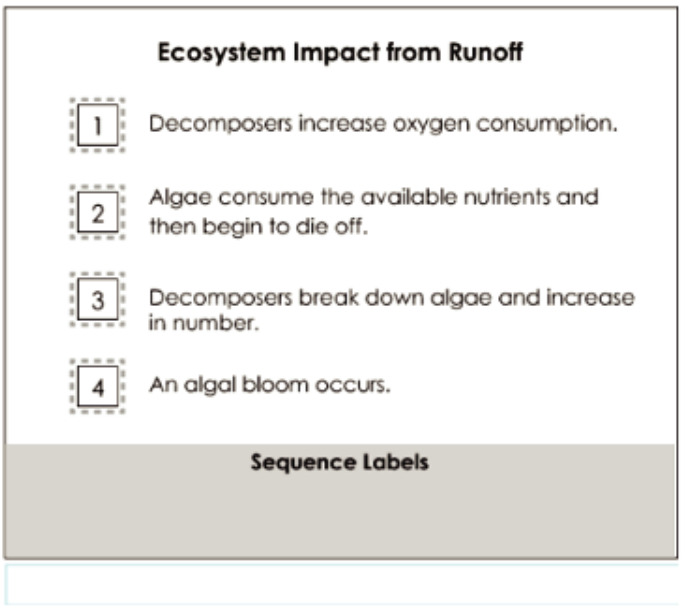
This response earns full credit (1 point) because it shows the correct sequence from top to bottom as 4, 2, 3, 1. First, an algal bloom occurs. Second, algae consume the available nutrients and then begin to die off. The third event is decomposers break down algae and increase in number. Finally, decomposers increase oxygen consumption.

Sample Response: 0 points

Oxygen depletion, also known as hypoxia, is one result of runoff from over-fertilized lawns or farmland. After heavy rains, nutrient-rich water enters the local aquatic environment, causing a series of events to occur within the ecosystem.

Some events caused by nutrient-rich runoff entering a lake ecosystem are shown.

Move the sequence labels into the blank boxes to sequence the correct order of these events.



Notes on Scoring

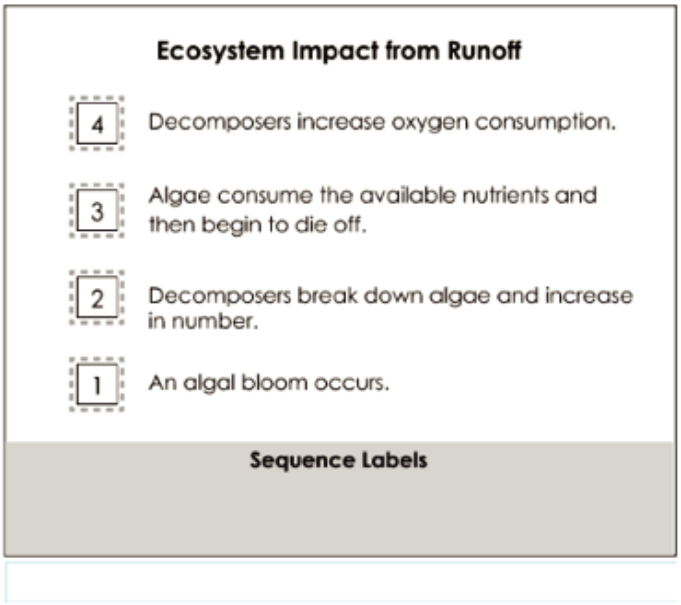
This response earns no credit (0 points) because it shows an incorrect sequence (1, 2, 3, 4) for these events caused by nutrient-rich runoff.

Sample Response: 0 points

Oxygen depletion, also known as hypoxia, is one result of runoff from over-fertilized lawns or farmland. After heavy rains, nutrient-rich water enters the local aquatic environment, causing a series of events to occur within the ecosystem.

Some events caused by nutrient-rich runoff entering a lake ecosystem are shown.

Move the sequence labels into the blank boxes to sequence the correct order of these events.



Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect sequence (4, 3, 2, 1) that is not the order for these events caused by nutrient-rich runoff.

Biology
Practice Test

Question 11

Question and Scoring Guidelines

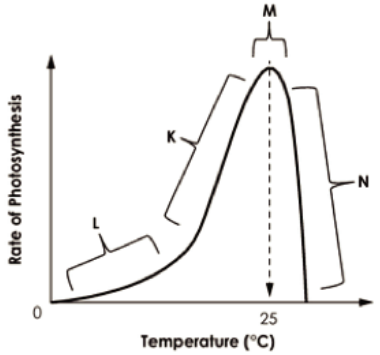
Question 11

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Students in a biology class conduct an experiment to determine the effect of temperature on the rate of photosynthesis in a plant. They place an *Elodea* plant into a test tube filled with water. Then, the students place the test tube under a light and slowly increase the temperature of the water. They record their results and display them on a graph as shown.

Photosynthesis vs. Temperature Experiment



Which statement is supported by the data in the graph?

Ⓐ The rate of oxygen production is lowest in section M.

Ⓑ The rate of oxygen production is greatest in section M.

Ⓒ The production of water molecules is greatest in section L.

Ⓓ The number of carbon dioxide molecules in the beaker is greatest in section K.

Part B

Which statement explains the effect of temperature on the rate of photosynthesis?

Ⓐ Oxygen molecules break down at temperatures above 25°*C*.

Ⓑ The rate of photosynthesis is unaffected by the temperature of the water.

Ⓒ The number of chloroplasts in the cell decreases as temperature increases.

Ⓓ Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°*C*.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Part A

Rationale for Option A: This is incorrect. The rate of photosynthesis peaks at 25°C.

Rationale for Option B: **Key** – As photosynthesis continues, more oxygen is produced.

Rationale for Option C: This is incorrect. Water is a reactant for photosynthesis and not a product.

Rationale for Option D: This is incorrect. The greatest number of carbon dioxide molecules is found at the beginning of the reaction.

Part B

Rationale for Option A: This is incorrect. Oxygen is a stable product of photosynthesis and is not affected by the temperature of the water.

Rationale for Option B: This is incorrect. The rate of photosynthesis decreases at temperatures above 25°C.

Rationale for Option C: This is incorrect. A decrease in the number of chloroplasts would result in a decrease in the rate of photosynthesis.

Rationale for Option D: **Key** – Above the optimal temperature (25°C), enzyme activity is reduced and the enzymes may cease to function, prohibiting photosynthesis.

Alignment

Topic
Cells

Subtopic
Cellular Processes

Content Elaboration
Cell functions are regulated. Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Most cells function within a narrow range of temperature and pH. At very low temperatures, reaction rates are slow. High temperatures and/or extremes of pH can

irreversibly change the structure of most protein molecules. Even small changes in pH can alter how molecules interact.

Cognitive Demand

Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item

This item requires the student to apply their understanding of how cellular environments affect the shape and function of enzymes in order to explain the effect of temperature on the rate of photosynthesis. An Elodea plant is placed in a test tube filled with water and exposed to light, which increases the temperature of water and the rate of photosynthesis. The graph is sectioned into four parts, and the students are asked to select a statement that is supported by the graph. Then, they are asked to explain the effect of temperature on the rate of photosynthesis.

Biology
Practice Test

Question 11

Sample Responses

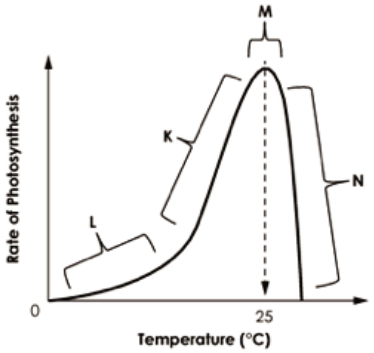
Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Students in a biology class conduct an experiment to determine the effect of temperature on the rate of photosynthesis in a plant. They place an *Elodea* plant into a test tube filled with water. Then, the students place the test tube under a light and slowly increase the temperature of the water. They record their results and display them on a graph as shown.

Photosynthesis vs. Temperature Experiment



Which statement is supported by the data in the graph?

Ⓐ The rate of oxygen production is lowest in section M.

● The rate of oxygen production is greatest in section M.

Ⓒ The production of water molecules is greatest in section L.

Ⓓ The number of carbon dioxide molecules in the beaker is greatest in section K.

Part B

Which statement explains the effect of temperature on the rate of photosynthesis?

Ⓐ Oxygen molecules break down at temperatures above 25°C.

Ⓑ The rate of photosynthesis is unaffected by the temperature of the water.

Ⓒ The number of chloroplasts in the cell decreases as temperature increases.

● Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°C.

Notes on Scoring

This response earns full credit (1 point) because it correctly selects "Option B" for Part A and "Option D" for Part B. "Option B, The rate of oxygen production is greatest in section M" is the correct choice for Part A because as photosynthesis continues, more oxygen is produced. "Option D, Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°C" is the correct choice for Part B because above the optimal temperature of 25°C, enzyme activity is reduced and may cease to function.

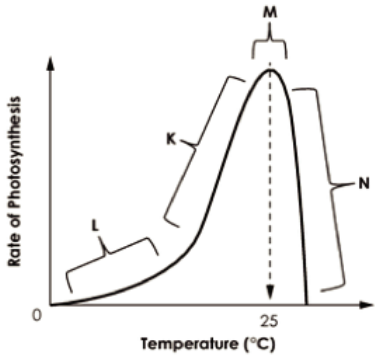
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Students in a biology class conduct an experiment to determine the effect of temperature on the rate of photosynthesis in a plant. They place an *Elodea* plant into a test tube filled with water. Then, the students place the test tube under a light and slowly increase the temperature of the water. They record their results and display them on a graph as shown.

Photosynthesis vs. Temperature Experiment



Which statement is supported by the data in the graph?

Ⓐ The rate of oxygen production is lowest in section M.

● The rate of oxygen production is greatest in section M.

Ⓒ The production of water molecules is greatest in section L.

Ⓓ The number of carbon dioxide molecules in the beaker is greatest in section K.

Part B

Which statement explains the effect of temperature on the rate of photosynthesis?

● Oxygen molecules break down at temperatures above 25°C.

Ⓑ The rate of photosynthesis is unaffected by the temperature of the water.

Ⓒ The number of chloroplasts in the cell decreases as temperature increases.

Ⓓ Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°C.

Notes on Scoring

This response earns no credit (0 points) because it incorrectly selects "Option A" for Part B. Both Part A and Part B must be correct for full credit.

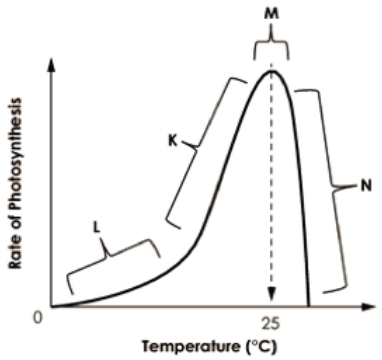
Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

Students in a biology class conduct an experiment to determine the effect of temperature on the rate of photosynthesis in a plant. They place an *Elodea* plant into a test tube filled with water. Then, the students place the test tube under a light and slowly increase the temperature of the water. They record their results and display them on a graph as shown.

Photosynthesis vs. Temperature Experiment



Which statement is supported by the data in the graph?

Ⓐ The rate of oxygen production is lowest in section M.

Ⓑ The rate of oxygen production is greatest in section M.

● The production of water molecules is greatest in section L.

Ⓓ The number of carbon dioxide molecules in the beaker is greatest in section K.

Part B

Which statement explains the effect of temperature on the rate of photosynthesis?

Ⓐ Oxygen molecules break down at temperatures above 25°*C*.

Ⓑ The rate of photosynthesis is unaffected by the temperature of the water.

● The number of chloroplasts in the cell decreases as temperature increases.

Ⓓ Enzymes involved with plant photosynthesis are disrupted at temperatures above 25°*C*.

Notes on Scoring

This response earns no credit (0 points) because both selections are incorrect: "Option C" for Part A and "Option C" for Part B. Both Part A and Part B must be correct for full credit.

Biology
Practice Test

Question 12

Question and Scoring Guidelines

Question 12

A scientist is examining a pedigree that includes several generations of an organism with XX/XY chromosome sex determination.

Which pattern of inheritance would support the hypothesis that the trait being studied is a recessive sex-linked trait found on the X chromosome?

Ⓐ The trait is only expressed in males who have a father with the trait.

Ⓑ The trait is expressed in half of the female organisms and all of the male organisms.

Ⓒ The trait is mostly expressed in males who have a maternal grandfather with the trait.

Ⓓ The trait is mostly expressed in females who have a paternal grandmother with the trait.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. A son can only inherit an X-linked trait from his mother. A father only contributes a Y chromosome to his sons.

Rationale for Option B: This is incorrect. Sex-linked traits are typically expressed in higher frequency in males than females. However, it would not be typical for all of the males to express the trait.

Rationale for Option C: **Key** – The maternal grandfather passes the X-linked trait to the mother and the mother passes the X-linked trait to the son. This is a typical pattern of inheritance for an X-linked trait.

Rationale for Option D: This is incorrect. Since the X-linked trait is recessive, females would have to inherit the trait from both mother and father in order to express the trait.

Alignment

Topic
Heredity

Subtopic
Genetic Mechanisms and Inheritance

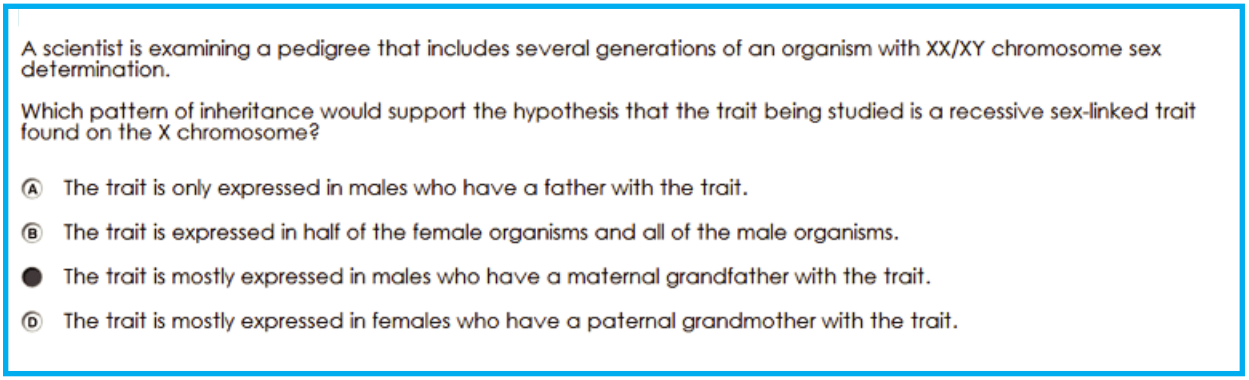
Content Elaboration
In high school, genetic mechanisms (both classical and modern), including incomplete dominance, sex-linked traits, goodness of fit test (Chi-square) and dihybrid crosses, are investigated through real-world examples.

Cognitive Demand
Demonstrating Science Knowledge (D)

Requires students to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather and organize data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.

Explanation of the Item
This item requires the student to use knowledge of sex-linked patterns of inheritance (XX/XY chromosome sex determination) in order to determine which information supports the hypothesis that the trait being studied is a recessive sex-linked trait found on the X chromosome.

Sample Response: 1 point



A scientist is examining a pedigree that includes several generations of an organism with XX/XY chromosome sex determination.

Which pattern of inheritance would support the hypothesis that the trait being studied is a recessive sex-linked trait found on the X chromosome?

Ⓐ The trait is only expressed in males who have a father with the trait.

Ⓑ The trait is expressed in half of the female organisms and all of the male organisms.

● The trait is mostly expressed in males who have a maternal grandfather with the trait.

Ⓓ The trait is mostly expressed in females who have a paternal grandmother with the trait.

Biology
Practice Test

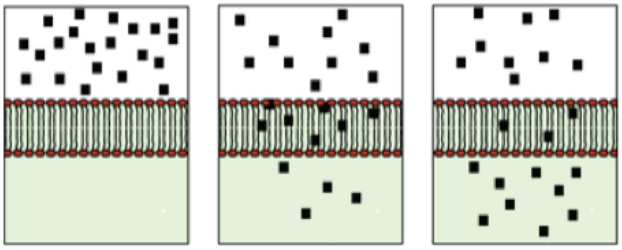
Question 13

Question and Scoring Guidelines

Question 13

The diagram models the time-lapse movement of particles across a cell membrane. The particles have characteristics that allow them to pass freely across the membrane.

Particles Crossing a Membrane over Time



Time 1 Time 2 Time 3

Select all of the statements that describe the particles or their movement based on the time-lapse diagram.

- ☐ The particles crossing the membrane do not have a charge.
- ☐ The movement across the membrane requires energy from ATP.
- ☐ The movement across the membrane requires energy from glucose.
- ☐ The movement across the membrane does not require added energy.
- ☐ The particles crossing the membrane could be proteins or carbohydrates.
- ☐ The particles crossing the membrane could be water (H_2O) or oxygen (O_2).
- ☐ The particles crossing the membrane have a strong positive or negative charge.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: **Key** – Only small, uncharged particles like water and oxygen can diffuse across the cell membrane.

Rationale for Option B: This is incorrect. Diffusion does not require ATP.

Rationale for Option C: This is incorrect. Diffusion is not powered by glucose.

Rationale for Option D: **Key** – Diffusion or osmosis does not require additional energy from ATP.

Rationale for Option E: This is incorrect. Large molecules cannot diffuse across the cell membrane without transport proteins.

Rationale for Option F: **Key** – Only small, uncharged particles like water, oxygen and carbon dioxide can diffuse across the cell membrane.

Rationale for Option G: This is incorrect. Charged particles cannot diffuse across the membrane without the aid of a membrane protein.

Alignment

Topic
Cells

Subtopic
Cell Structure and Function

Content Elaboration
Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape. Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This multi-select item requires the student to interpret the particle movement across a phospholipid bilayer membrane. Diffusion is occurring in the diagram.

Biology
Practice Test

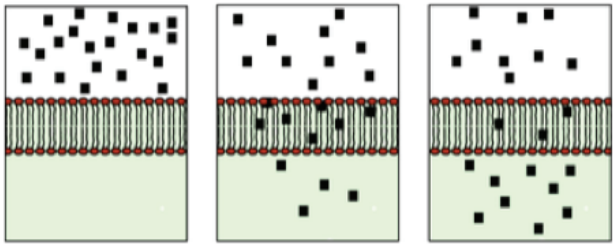
Question 13

Sample Responses

Sample Response: 1 point

The diagram models the time-lapse movement of particles across a cell membrane. The particles have characteristics that allow them to pass freely across the membrane.

Particles Crossing a Membrane over Time



Select all of the statements that describe the particles or their movement based on the time-lapse diagram.

- [x] The particles crossing the membrane do not have a charge.
- [ ] The movement across the membrane requires energy from ATP.
- [ ] The movement across the membrane requires energy from glucose.
- [x] The movement across the membrane does not require added energy.
- [ ] The particles crossing the membrane could be proteins or carbohydrates.
- [x] The particles crossing the membrane could be water (H_2O) or oxygen (O_2).
- [ ] The particles crossing the membrane have a strong positive or negative charge.

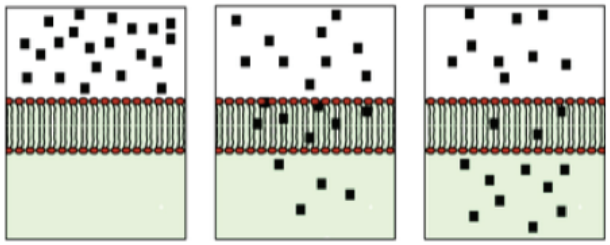
Notes on Scoring

This response earns full credit (1 point) because it correctly indicates "Option A," "Option D" and "Option F" as statements that describe the particles or their movement based on the time-lapse diagram. "Option A" is a correct statement because only small, uncharged particles like water and oxygen can diffuse across the cell membrane. "Option D" is correct because diffusion or osmosis do not require additional energy from ATP. "Option F" is correct because only small, uncharged particles like water and oxygen can diffuse across the cell membrane.

Sample Response: 0 points

The diagram models the time-lapse movement of particles across a cell membrane. The particles have characteristics that allow them to pass freely across the membrane.

Particles Crossing a Membrane over Time



Time 1 Time 2 Time 3

Select all of the statements that describe the particles or their movement based on the time-lapse diagram.

- [x] The particles crossing the membrane do not have a charge.
- [ ] The movement across the membrane requires energy from ATP.
- [ ] The movement across the membrane requires energy from glucose.
- [ ] The movement across the membrane does not require added energy.
- [x] The particles crossing the membrane could be proteins or carbohydrates.
- [x] The particles crossing the membrane could be water (H_2O) or oxygen (O_2).
- [ ] The particles crossing the membrane have a strong positive or negative charge.

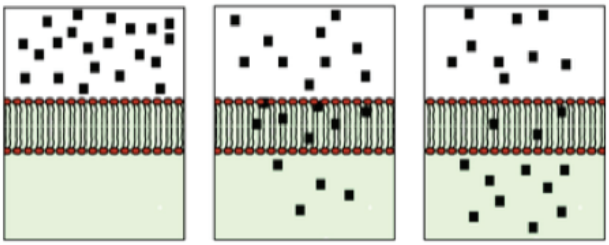
Notes on Scoring

This response earns no credit (0 points) because it incorrectly indicates "Option E." "Option E" is not a correct statement because large molecules, like proteins or carbohydrates, cannot diffuse across the cell membrane.

Sample Response: 0 points

The diagram models the time-lapse movement of particles across a cell membrane. The particles have characteristics that allow them to pass freely across the membrane.

Particles Crossing a Membrane over Time



Select all of the statements that describe the particles or their movement based on the time-lapse diagram.

- [ ] The particles crossing the membrane do not have a charge.
- [ ] The movement across the membrane requires energy from ATP.
- [x] The movement across the membrane requires energy from glucose.
- [x] The movement across the membrane does not require added energy.
- [ ] The particles crossing the membrane could be proteins or carbohydrates.
- [ ] The particles crossing the membrane could be water (H_2O) or oxygen (O_2).
- [ ] The particles crossing the membrane have a strong positive or negative charge.

Notes on Scoring

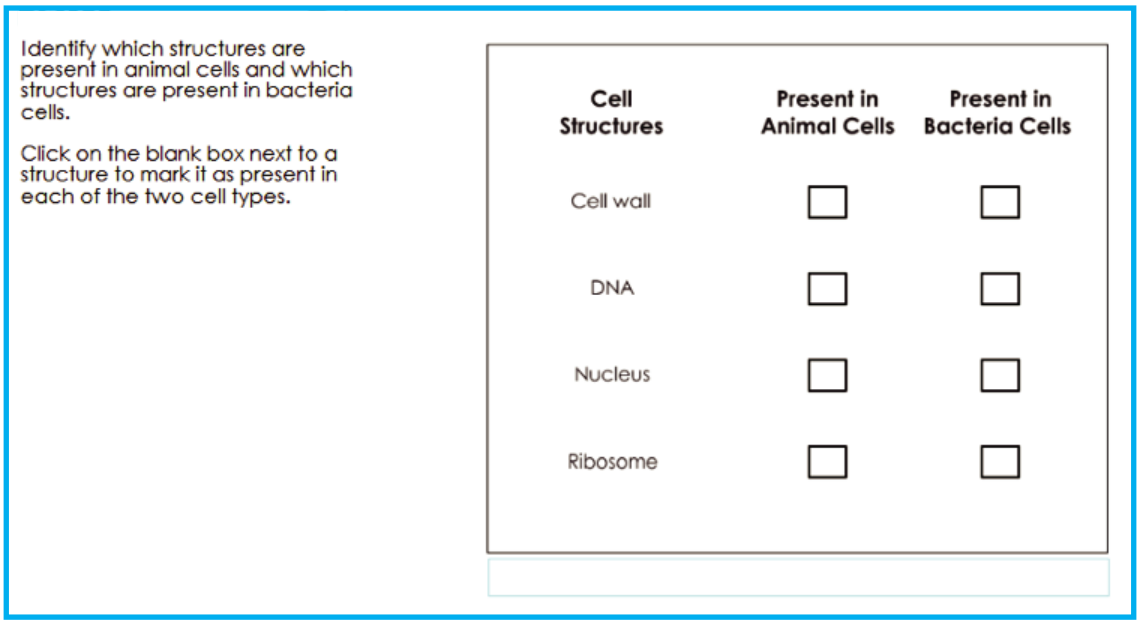
This response earns no credit (0 points) because it incorrectly indicates "Option C." "Option C" is not correct because diffusion across the membrane is not powered by glucose. Although "Option D" was selected, "Option F" was not. The correct selections are "Option A," "Option D" and "Option F," statements that describe the particles or their movement based on the time-lapse diagram.

Biology
Practice Test

Question 14

Question and Scoring Guidelines

Question 14



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Cell wall" selected for "Bacteria Cells;"

  AND

- "DNA" selected for both;

  AND

- "Nucleus" selected for "Animal Cells;"

  AND

- "Ribosome" selected for both (1 point).

Alignment

Topic
Cells

Subtopic
Cell Structure and Function

Content Elaboration
Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This graphic response item requires the student to identify which structures (cell wall, DNA, nucleus, ribosomes) are present or absent in animal and bacteria cells.

Bacteria cells will have DNA, cell wall and ribosome checked. Animal cells will have DNA, nucleus and ribosome checked.

Biology
Practice Test

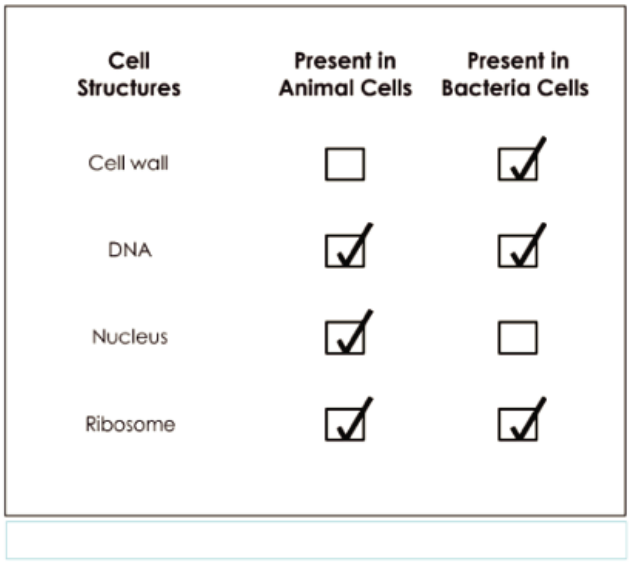
Question 14

Sample Responses

Sample Response: 1 point

Identify which structures are present in animal cells and which structures are present in bacteria cells.

Click on the blank box next to a structure to mark it as present in each of the two cell types.



Cell Structures	Present in Animal Cells	Present in Bacteria Cells
Cell wall	☐	☑
DNA	☑	☑
Nucleus	☑	☐
Ribosome	☑	☑

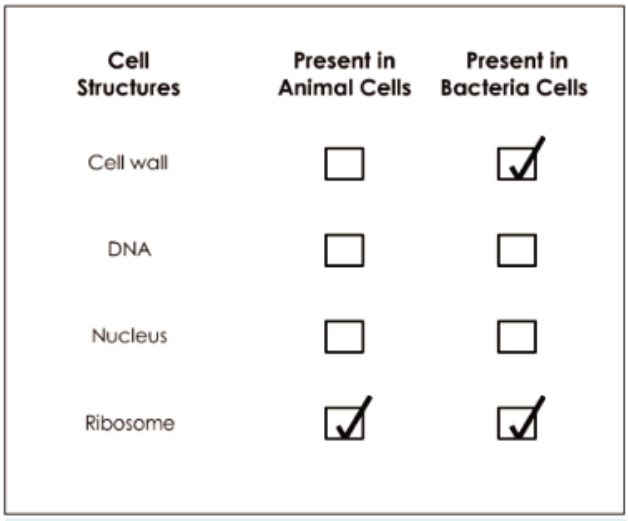
Notes on Scoring

This response earns full credit (1 point) because it correctly indicates that a cell wall is present in bacteria cells, that DNA is present in both animal and bacteria cells, that a nucleus is present in animal cells and that ribosomes are found in both animal and bacteria cells.

Sample Response: 0 points

Identify which structures are present in animal cells and which structures are present in bacteria cells.

Click on the blank box next to a structure to mark it as present in each of the two cell types.



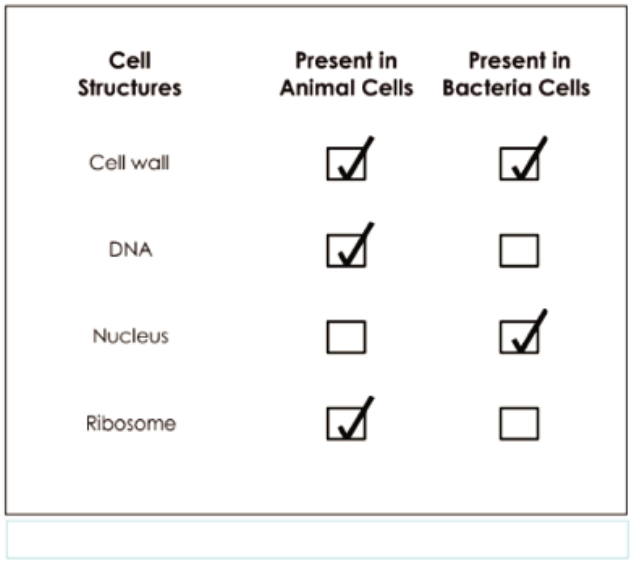
Notes on Scoring

This response earns no credit (0 points) because it incorrectly indicates that DNA and a nucleus are not found in animal or bacteria cells. The correct answer should indicate that a cell wall is present in bacteria cells, that DNA is present in both animal and bacteria cells, that a nucleus is present in animal cells and that ribosomes are found in both animal and bacteria cells.

Sample Response: 0 points

Identify which structures are present in animal cells and which structures are present in bacteria cells.

Click on the blank box next to a structure to mark it as present in each of the two cell types.



Notes on Scoring

This response earns no credit (0 points) because it incorrectly indicates that a cell wall is present in animal cells, that DNA is not present in bacteria cells, that a nucleus is present in bacteria cells and that ribosomes are present in only animal cells. The correct answer should indicate that a cell wall is present in bacteria cells only, that DNA is present in both animal and bacteria cells, that a nucleus is present in animal cells and that ribosomes are found in both animal and bacteria cells.

Biology
Practice Test

Question 15

Question and Scoring Guidelines

Question 15

The table shows sample cells taken from tissues of two individuals of the same species. DNA from each cell is analyzed using gel electrophoresis.

Gel Electrophoresis Cell Comparison

Cell	Tissue Source Individual A	Tissue Source Individual B
1	Liver	Liver
2	Lung	Skin
3	Muscle	Muscle
4	Blood	Pancreas

Which prediction will be supported by the results of the gel electrophoresis analysis?

Ⓐ Cell 1 from Individual A will have an identical banding pattern compared to Cell 1 from Individual B.

Ⓑ Cell 1 from Individual A will have an identical banding pattern compared to Cell 2 from Individual A.

Ⓒ Cell 1 from Individual A will have a different banding pattern compared to Cell 3 from Individual A.

Ⓓ Cell 1 from Individual A will have a different banding pattern compared to Cell 4 from Individual A.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. DNA taken from different individuals will produce different gel banding patterns.

Rationale for Option B: **Key** – Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

Rationale for Option C: This is incorrect. Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

Rationale for Option D: This is incorrect. Diploid cells taken from the same individual will produce almost identical gel electrophoresis patterns since each cell has the identical genetic make-up.

Alignment

Topic
Heredity

Subtopic
Modern Genetics

Content Elaboration
"The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. Different genes are active in different types of cells, influenced by the cell's environment and past history." (American Association for the Advancement of Science)

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This multiple choice item requires the student to predict the results of a gel electrophoresis comparison between two organisms. Gel electrophoresis is a process used to separate DNA into bands that can be used for determining relationships among organisms. The cells of an individual organism have identical genetic make-up, but cells in various portions of the body have different functions.

Sample Response: 1 point

The table shows sample cells taken from tissues of two individuals of the same species. DNA from each cell is analyzed using gel electrophoresis.

Gel Electrophoresis Cell Comparison

Cell	Tissue Source Individual A	Tissue Source Individual B
1	Liver	Liver
2	Lung	Skin
3	Muscle	Muscle
4	Blood	Pancreas

Which prediction will be supported by the results of the gel electrophoresis analysis?

Ⓐ Cell 1 from Individual A will have an identical banding pattern compared to Cell 1 from Individual B.

● Cell 1 from Individual A will have an identical banding pattern compared to Cell 2 from Individual A.

Ⓒ Cell 1 from Individual A will have a different banding pattern compared to Cell 3 from Individual A.

Ⓓ Cell 1 from Individual A will have a different banding pattern compared to Cell 4 from Individual A.

Biology
Practice Test

Question 16

Simulation for Question 17

Question 16 (Simulation for Question 17)

To understand how reactions happen in cells, scientists often isolate enzymes and their substrates to conduct experiments in laboratories. The enzymes and substrates used in the following experiment are involved in reactions that produce gas, which can be collected and measured.

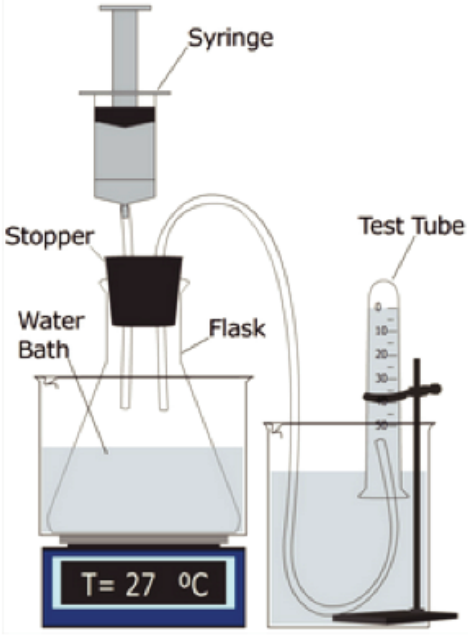
Select an enzyme, a substrate and a temperature. Then click Start to conduct a study of enzyme activity. The results will appear in the table below.

Enzyme 1

Substrate A

Temperature (degrees C) 27

Start



Clear All Rows

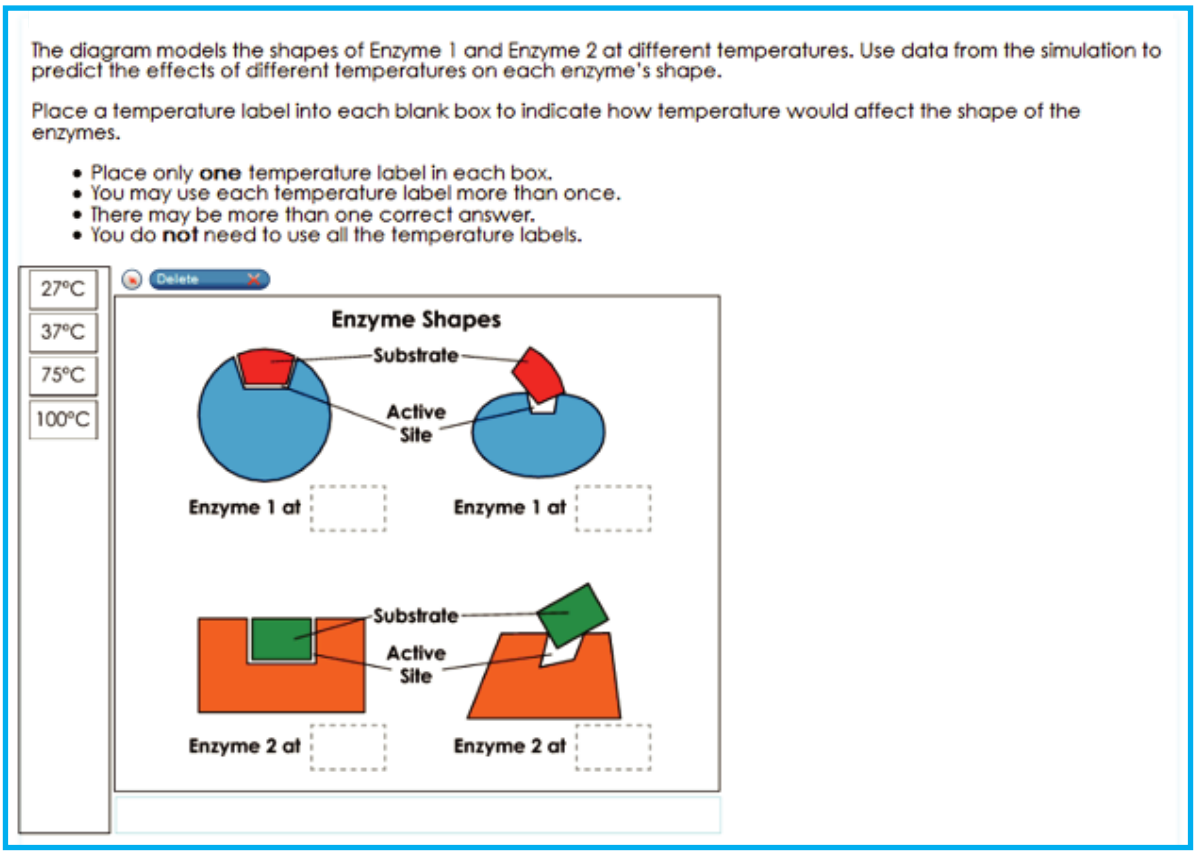
Enzyme	Substrate	Temperature (C)	Water Displaced (mL)	Bubbles

Biology
Practice Test

Question 17

Question and Scoring Guidelines

Question 17



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- For Enzyme 1: "27°C" OR "37°C" placed in left box, and "75°C" OR "100°C" placed in right box;

  AND

- For Enzyme 2: "27°C" OR "37°C" OR "75°C" placed in left box, and ONLY "100°C" placed in right box (1 point).

Alignment

Topic
Cells

Subtopic
Cellular Processes

Content Elaboration
Cell functions are regulated. Complex interactions among the different kinds of molecules in the cell cause distinct cycles of activities, such as growth and division. Most cells function within a narrow range of temperature and pH. At very low temperatures, reaction rates are slow. High temperatures and/or extremes of pH can irreversibly change the structure of most protein molecules. Even small changes in pH can alter how molecules interact.

Cognitive Demand
Demonstrating Science Knowledge (D)

Requires students to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather and organize data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.

Explanation of the Item
This item requires the student to determine the optimal conditions for enzymatic reactions. The student makes a prediction about how different temperatures can influence enzyme shape and activity. The simulation explores the reaction of enzymes and substrates at four temperature ranges. Enzyme 1 and Substrate A produce gas at lower temperatures (27°C and 37°C), and at high temperatures (75°C and 100°C) no reaction takes place. Enzyme 1 and Substrate B have no reaction at any temperature. Enzyme 2 and Substrate A have no reaction at any temperature. Enzyme 2 and Substrate B increase gas production as the temperature increases until it hits 100°C. At 100°C, there is no reaction. The enzyme is denatured.

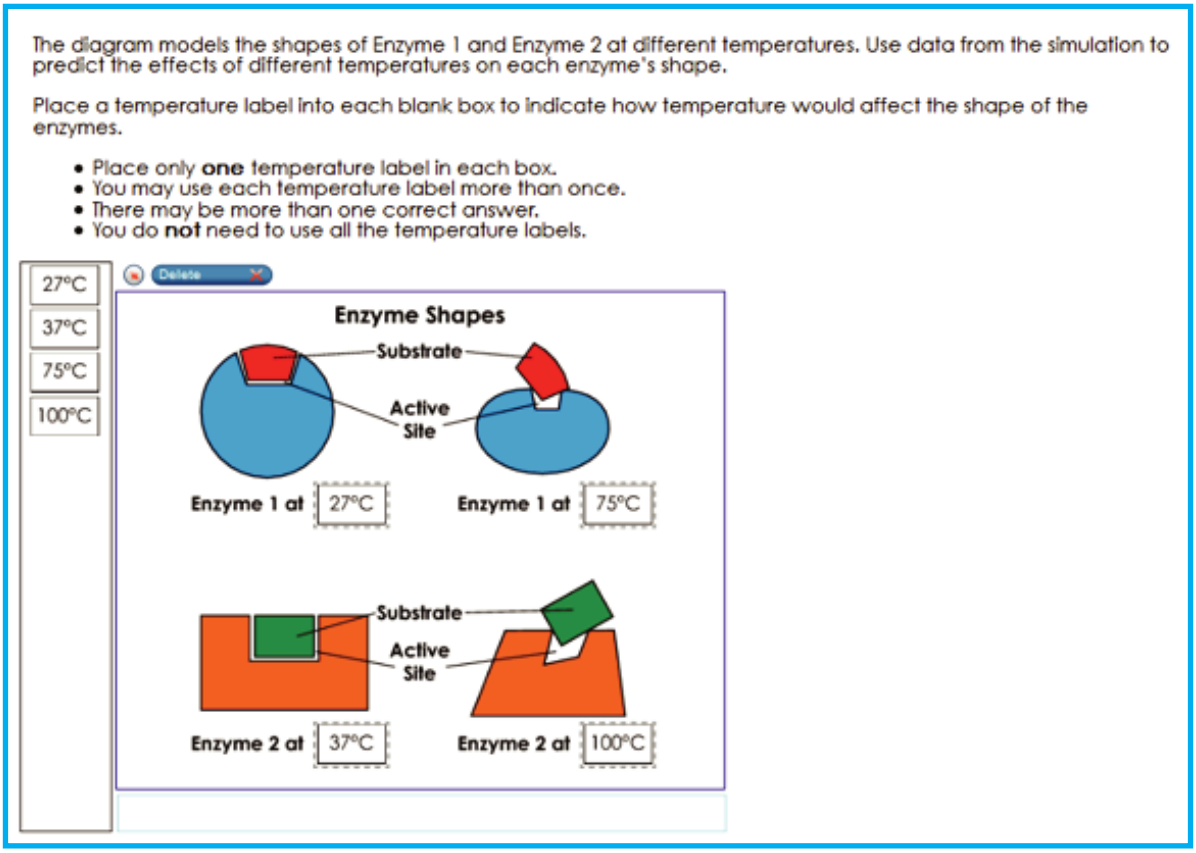
To address this item, Enzyme 1 is functional at 27°C or 37°C and denatured at 75°C or 100°C. Enzyme 2 is functional at 27°C or 37°C or 75°C. It is denatured at 100°C.

Biology
Practice Test

Question 17

Sample Responses

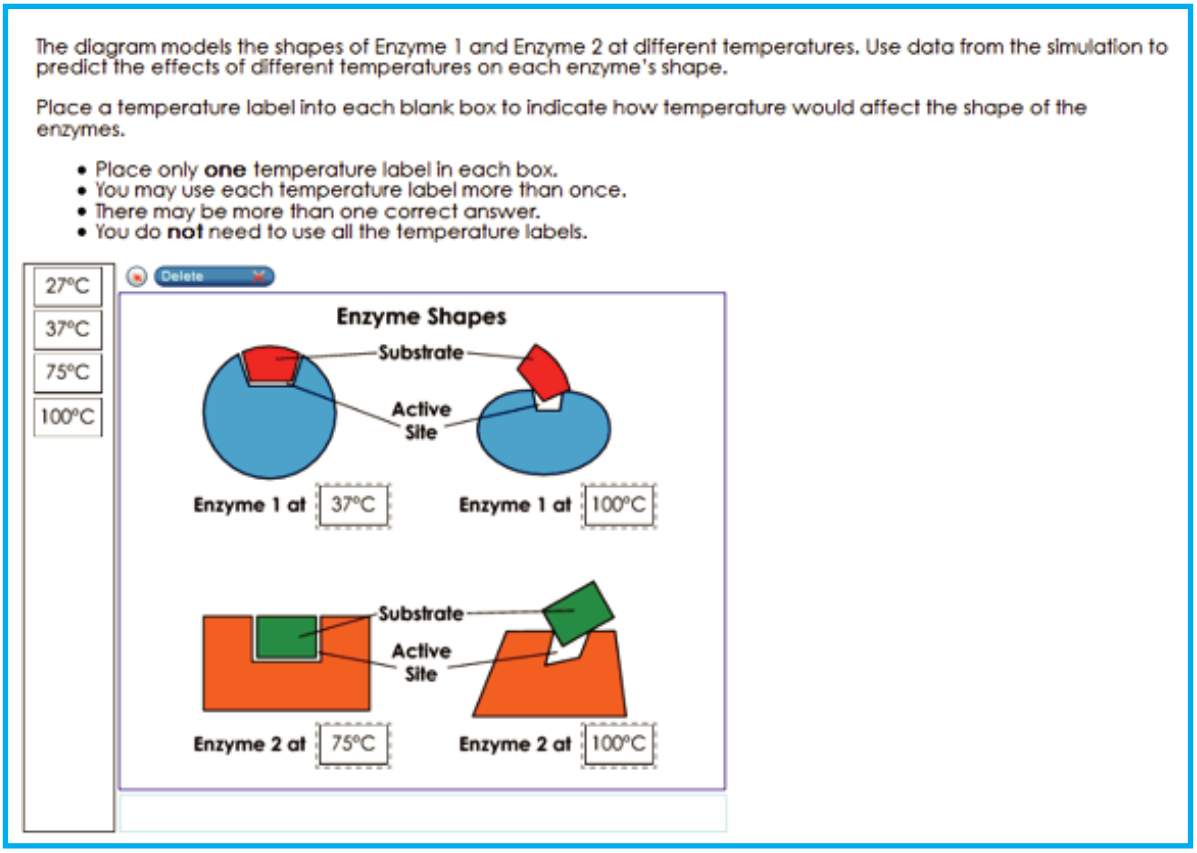
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because for Enzyme 1 it indicates "27°C" and "75°C," and for Enzyme 2, "37°C" and "100°C." For this item, for Enzyme 1, a full-credit response includes "27°C" or "37°C" placed in the left box and "75°C" or "100°C" placed in the right box. For Enzyme 2, a full-credit response includes "27°C" or "37°C" or "75°C" placed in the left box and ONLY "100°C" placed in the right box.

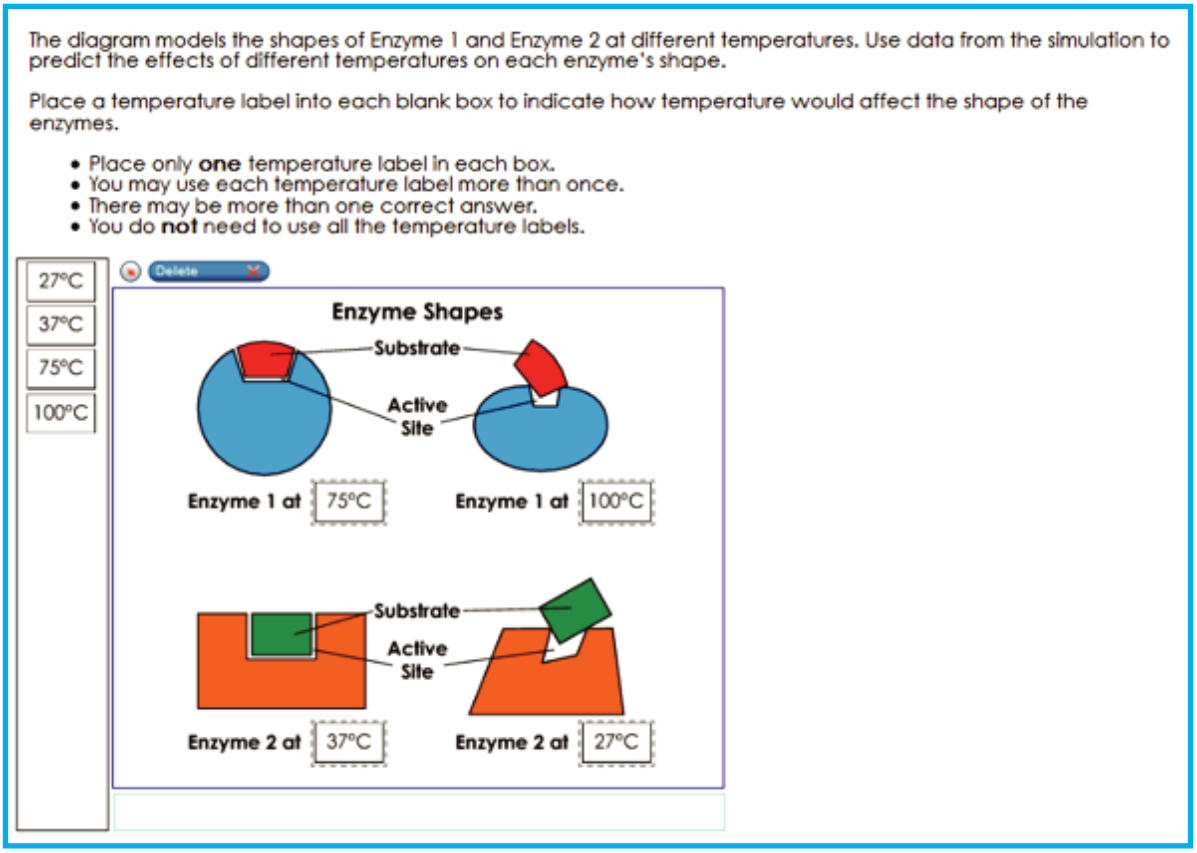
Sample Response: 1 point



Notes on Scoring

This response earns full credit (1 point) because for Enzyme 1 it indicates "37°C" and "100°C," and for Enzyme 2, "75°C" and "100°C" are selected.

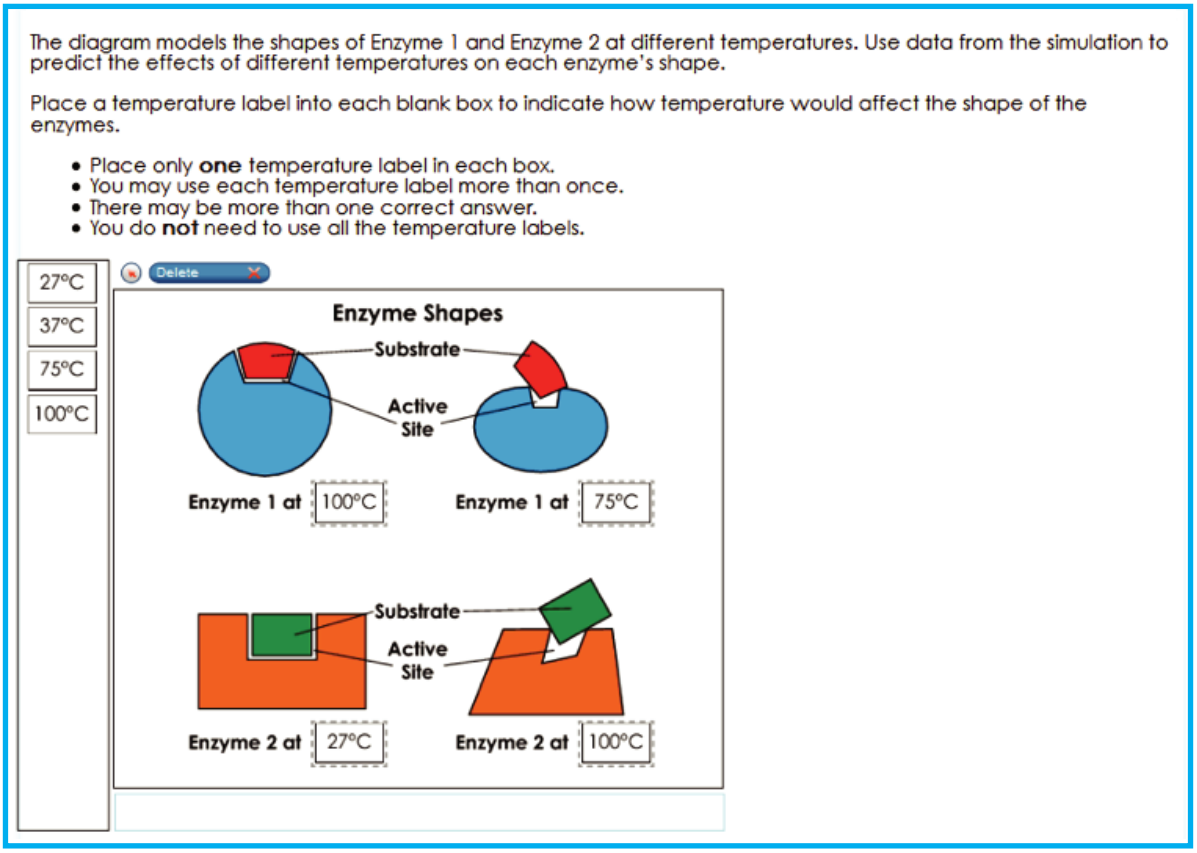
Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because for Enzyme 1 it indicates "75°C" and "100°C," and for Enzyme 2, "37°C" and "27°C" are selected.

Sample Response: 0 points



Notes on Scoring

This response earns no credit (0 points) because for Enzyme 1, "100°C" (a temperature that is too high) for the left box is selected. To earn full credit on this item, appropriate temperature for all four boxes must be selected.

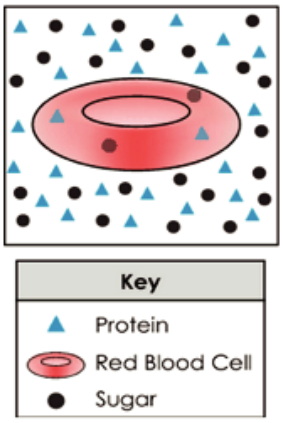
Biology
Practice Test

Question 18

Question and Scoring Guidelines

Question 18

A red blood cell is placed into an aqueous solution. The red blood cell has a lower concentration of protein and sugar than the aqueous solution, as shown in the diagram. In the diagram, the volume of the cell is equal to the volume outside the cell.



What is most likely to occur?

Ⓐ Water from the solution will diffuse into the red blood cell.

Ⓑ Water from the red blood cell will diffuse into the solution.

Ⓒ Protein and sugar from the solution will diffuse into the red blood cell.

Ⓓ Protein and sugar from the red blood cell will diffuse into the solution.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Water will diffuse out of the cell.

Rationale for Option B: **Key** – Water will diffuse from high concentration (in the cell) to low concentration (out of the cell).

Rationale for Option C: This is incorrect. Sugar and proteins cannot diffuse into a red blood cell.

Rationale for Option D: This is incorrect. Sugar and proteins cannot diffuse into a red blood cell.

Alignment

Topic
Cells

Subtopic
Cellular Processes

Content Elaboration
Every cell is covered by a membrane that controls what can enter and leave the cell. In all but quite primitive cells, a complex network of proteins provides organization and shape. Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback, and movement. In addition to these basic cellular functions, most cells in multicellular organisms perform some specific functions that others do not.

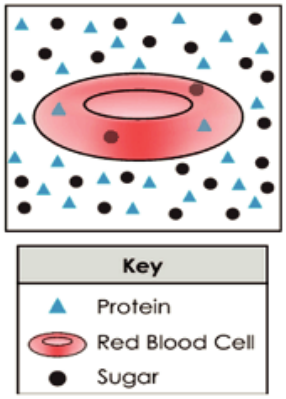
Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to understand diffusion and osmosis in the context of a red blood cell in an aqueous solution. The red blood cell has a lower concentration of protein and sugar than the solution in which it is placed. This will cause water to flow from the cell to the solution.

Sample Response: 1 point

A red blood cell is placed into an aqueous solution. The red blood cell has a lower concentration of protein and sugar than the aqueous solution, as shown in the diagram. In the diagram, the volume of the cell is equal to the volume outside the cell.



What is most likely to occur?

Ⓐ Water from the solution will diffuse into the red blood cell.

● Water from the red blood cell will diffuse into the solution.

Ⓒ Protein and sugar from the solution will diffuse into the red blood cell.

Ⓓ Protein and sugar from the red blood cell will diffuse into the solution.

Biology
Practice Test

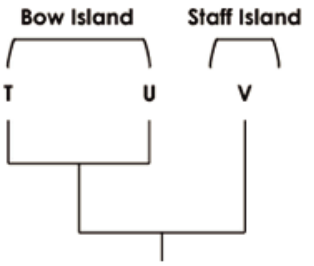
Question 19

Question and Scoring Guidelines

Question 19

Speciation is occurring in lizard populations on two isolated islands, Staff Island and Bow Island. Based on evidence collected over a long period of time, biologists create the lizard species cladogram shown.

Island Lizard Cladogram



Enter a number (1-4) next to each statement to identify the order in which the events must have occurred on these two islands.

Event Order	Statement
	Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island.
	Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island.
	Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring.
	The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- Statements ordered 2, 1, 4, 3 (1 point).

Alignment

Topic
Evolution

Subtopic
Diversity of Life

Content Elaboration
The basic concept of biological evolution is that the Earth's present-day species descended from earlier, common ancestral species. At the high school level, the term natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental effects upon the survival or reproduction of the individual with the trait. Different phenotypes result from new combinations of existing genes or from mutations of genes in reproductive cells. At the high school level, the expectation is to combine grade-8 knowledge with an explanation of the internal structure and function of chromosomes. Natural selection works on the phenotype.

Populations evolve over time. Evolution is the consequence of the interactions of:

1. The potential for a population to increase its numbers;
2. The genetic variability of offspring due to mutation and recombination of genes;
3. A finite supply of the resources required for life; and
4. The differential survival and reproduction of individuals with the specific phenotype.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to sequence speciation events in lizard populations on two isolated islands, Staff Island and Bow Island. A cladogram is provided to help illustrate the relationships between the populations.

Based on this information, the sequence of events indicates that biologists observe a population of lizards that inhabit Staff Island, but there are no lizards present on Bow Island. There are breeding pairs from Staff Island arriving on Bow Island. The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations. Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring. This means that these lizard populations are different species.

Biology
Practice Test

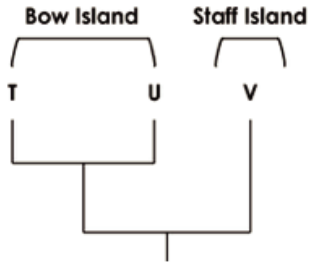
Question 19

Sample Responses

Sample Response: 1 point

Speciation is occurring in lizard populations on two isolated islands, Staff Island and Bow Island. Based on evidence collected over a long period of time, biologists create the lizard species cladogram shown.

Island Lizard Cladogram



Enter a number (1-4) next to each statement to identify the order in which the events must have occurred on these two islands.

Event Order	Statement
2	Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island.
1	Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island.
4	Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring.
3	The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

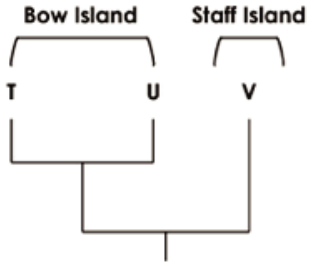
Notes on Scoring

This response earns full credit (1 point) because it correctly identifies the order in which the events must have occurred on these two islands. The correct order of events from top to bottom is: 2, Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island; 1, Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island; 4, Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring; and 3, The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Sample Response: 0 points

Speciation is occurring in lizard populations on two isolated islands, Staff Island and Bow Island. Based on evidence collected over a long period of time, biologists create the lizard species cladogram shown.

Island Lizard Cladogram



Enter a number (1-4) next to each statement to identify the order in which the events must have occurred on these two islands.

Event Order	Statement
1	Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island.
2	Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island.
3	Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring.
4	The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

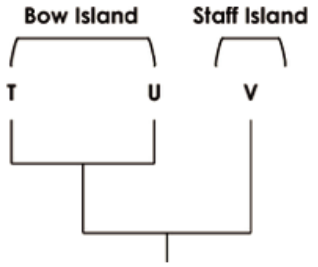
Notes on Scoring

This response earns no credit (0 points) because it incorrectly identifies the order in which the events must have occurred on these two islands as 1, 2, 3, 4. The correct order of events from top to bottom is: 2, Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island; 1, Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island; 4, Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring; and 3, The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Sample Response: 0 points

Speciation is occurring in lizard populations on two isolated islands, Staff Island and Bow Island. Based on evidence collected over a long period of time, biologists create the lizard species cladogram shown.

Island Lizard Cladogram



Enter a number (1-4) next to each statement to identify the order in which the events must have occurred on these two islands.

Event Order	Statement
2	Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island.
4	Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island.
1	Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring.
3	The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Notes on Scoring

This response earns no credit (0 points) because it incorrectly identifies the order in which the events must have occurred on these two islands as 2, 4, 1, 3. The correct order of events from top to bottom is: 2, Biologists observe lizard breeding pairs from Staff Island arriving on Bow Island; 1, Biologists observe a population of lizards that inhabits Staff Island, but that no lizards are present on Bow Island; 4, Biologists determine that experimental matings of lizards from different island lizard populations are unable to produce offspring; and 3, The lizards on Bow Island experience different selection pressures, and begin to occupy different niches over a number of generations.

Biology
Practice Test

Question 20

Question and Scoring Guidelines

Question 20

The table lists the presence or absence of genes for two proteins in different animal groups.

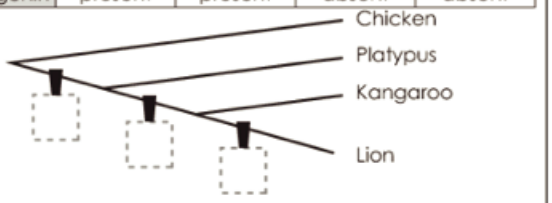
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

Move a label into each blank box.

- You may **not** need to fill in all of the blank boxes.
- You may **not** need to use all of the labels.

Comparison of Animal Groups

	Aves (birds)	Prototheria (egg-laying mammals)	Metatheria (marsupial mammals)	Eutheria (placental mammals)
Example	Chicken	Platypus	Kangaroo	Lion
Gene				
Casein	absent	present	present	present
Vitellogenin	present	present	absent	absent



C	C	V	V
gain of gene casein	loss of gene casein	gain of gene vitellogenin	loss of gene vitellogenin

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Gain of casein" placed in the left box;

  AND

- "Loss of vitellogenin" placed in the middle box;

  AND

- Nothing placed in the right box (1 point).

Alignment

Topic
Evolution

Subtopic
Diversity of Life

Content Elaboration
At the high school level, the term natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental effects upon the survival or reproduction of the individual with the trait.

Modern ideas about evolution provide a natural explanation for the diversity of life on Earth as represented in the fossil record, in the similarities of existing species and in modern molecular evidence. From a long-term perspective, evolution is the descent with modification of different lineages from common ancestors.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to use trait comparison data and a cladogram to determine when certain traits appeared or were lost among a group of organisms. The casein protein appeared in a group of organisms between the chicken and platypus. The protein vitellogenin was lost in a group of organisms between the platypus and kangaroo.

Biology
Practice Test

Question 20

Sample Responses

Sample Response: 1 point

The table lists the presence or absence of genes for two proteins in different animal groups.

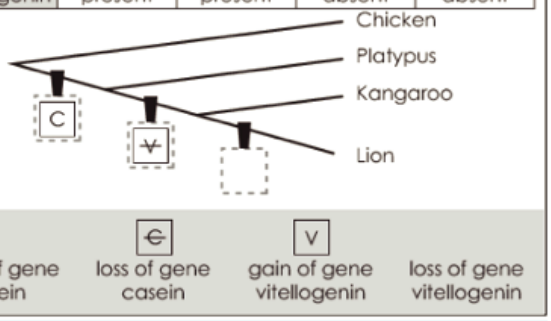
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

Move a label into each blank box.

- You may **not** need to fill in all of the blank boxes.
- You may **not** need to use all of the labels.

Comparison of Animal Groups

	Aves (birds)	Prototheria (egg-laying mammals)	Metatheria (marsupial mammals)	Eutheria (placental mammals)
Example	Chicken	Platypus	Kangaroo	Lion
Gene				
Casein	absent	present	present	present
Vitellogenin	present	present	absent	absent



gain of gene casein | loss of gene casein | gain of gene vitellogenin | loss of gene vitellogenin

Notes on Scoring

This response earns full credit (1 point) because it used the data in the table to correctly place the symbol for "gain of gene casein" in the left box, the symbol for "loss of gene vitellogenin" in the middle box and nothing in the right box to indicate when the genes for these proteins appeared or were lost within the cladogram shown. This is the only correct arrangement.

Sample Response: 0 points

The table lists the presence or absence of genes for two proteins in different animal groups.

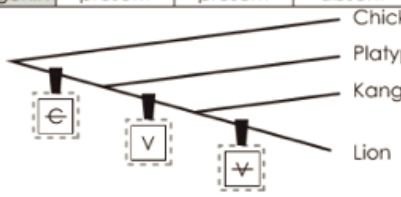
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

Move a label into each blank box.

- You may **not** need to fill in all of the blank boxes.
- You may **not** need to use all of the labels.

Comparison of Animal Groups

	Aves (birds)	Prototheria (egg-laying mammals)	Metatheria (marsupial mammals)	Eutheria (placental mammals)
Example	Chicken	Platypus	Kangaroo	Lion
Gene				
Casein	absent	present	present	present
Vitellogenin	present	present	absent	absent



C gain of gene casein | loss of gene casein | gain of gene vitellogenin | loss of gene vitellogenin

Notes on Scoring

This response earns no credit (0 points) because it places an incorrect symbol in each of the three boxes. For a full-credit response, the symbol for "gain of gene casein" must be placed in the left box, the symbol for "loss of gene vitellogenin" must be placed in the middle box and nothing should be placed in the right box to indicate when the genes for these proteins appeared or were lost within the cladogram shown.

Sample Response: 0 points

The table lists the presence or absence of genes for two proteins in different animal groups.

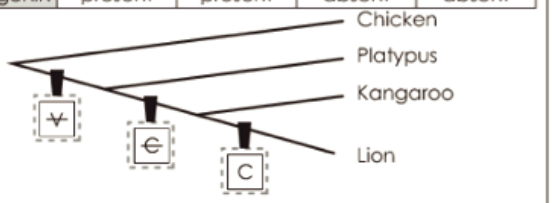
Use the data in the table to determine when the genes for these proteins appeared or were lost within the cladogram shown.

Move a label into each blank box.

- You may **not** need to fill in all of the blank boxes.
- You may **not** need to use all of the labels.

Comparison of Animal Groups

	Aves (birds)	Prototheria (egg-laying mammals)	Metatheria (marsupial mammals)	Eutheria (placental mammals)
Example	Chicken	Platypus	Kangaroo	Lion
Gene				
Casein	absent	present	present	present
Vitellogenin	present	present	absent	absent



Notes on Scoring

This response earns no credit (0 points) because it places an incorrect symbol in each of the three boxes. For a full-credit response, the symbol for "gain of gene casein" must be placed in the left box, the symbol for "loss of gene vitellogenin" must be placed in the middle box and nothing should be placed in the right box to indicate when the genes for these proteins appeared or were lost within the cladogram shown.

Biology
Practice Test

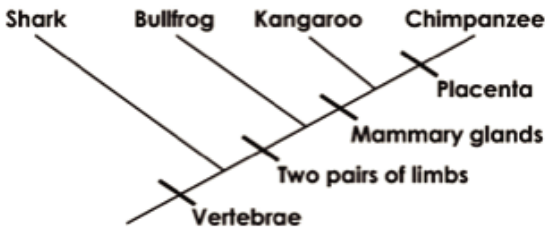
Question 21

Question and Scoring Guidelines

Question 21

The evolutionary relationships among four animals and four animal traits are shown in the cladogram.

Animal Cladogram



Select the boxes to identify the trait(s) that each animal possesses.

	Bullfrog	Chimpanzee	Kangaroo	Shark
Placenta	☐	☐	☐	☐
Vertebrae	☐	☐	☐	☐
Mammary glands	☐	☐	☐	☐
Two pairs of limbs	☐	☐	☐	☐

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "Placenta" selected for "Chimpanzee"

  AND

- "Vertebrae" selected for "Bullfrog," "Chimpanzee," "Kangaroo" and "Shark"

  AND

- "Mammary glands" selected for "Chimpanzee" and "Kangaroo"

  AND

- "Two pairs of limbs" selected for "Bullfrog," "Chimpanzee" and "Kangaroo" (1 point).

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.

Content Elaboration
Classification systems are frameworks developed by scientists for describing the diversity of organisms, indicating the degree of relatedness between organisms. Recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons. Both morphological comparisons and molecular evidence must be used to describe biodiversity (cladograms can be used to address this).

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to interpret a cladogram that displays four animals and four animal traits. The student is to select the traits that each animal possesses. The bullfrog has vertebrae and two pairs of limbs. The chimpanzee has all four traits. The kangaroo has vertebrae, two pairs of limbs and mammary glands. The shark has vertebrae.

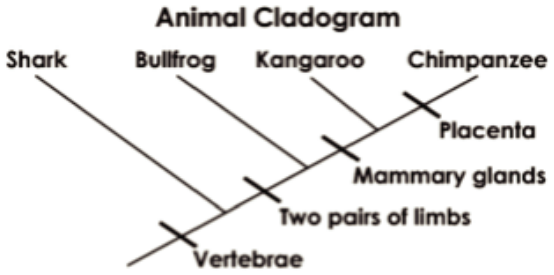
Biology
Practice Test

Question 21

Sample Responses

Sample Response: 1 point

The evolutionary relationships among four animals and four animal traits are shown in the cladogram.



Select the boxes to identify the trait(s) that each animal possesses.

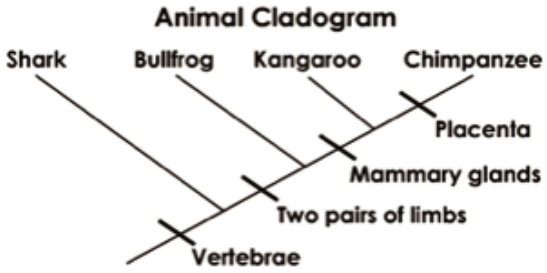
	Bullfrog	Chimpanzee	Kangaroo	Shark
Placenta	☐	☑	☐	☐
Vertebrae	☑	☑	☑	☑
Mammary glands	☐	☑	☑	☐
Two pairs of limbs	☑	☑	☑	☐

Notes on Scoring

This response earns full credit (1 point) because it correctly selects "Placenta" for "Chimpanzee," "Vertebrae" for all four animals, "Mammary glands" for "Chimpanzee" and "Kangaroo," and "Two pairs of limbs" for "Bullfrog," "Chimpanzee" and "Kangaroo" to identify the traits that each animal possesses based on the cladogram.

Sample Response: 0 points

The evolutionary relationships among four animals and four animal traits are shown in the cladogram.



Select the boxes to identify the trait(s) that each animal possesses.

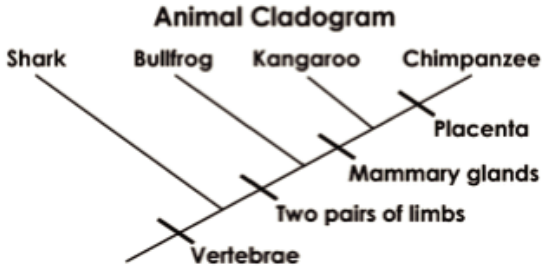
	Bullfrog	Chimpanzee	Kangaroo	Shark
Placenta	☐	☑	☐	☐
Vertebrae	☑	☐	☑	☑
Mammary glands	☐	☑	☑	☐
Two pairs of limbs	☑	☑	☑	☐

Notes on Scoring

This response earns no credit (0 points) because it does not identify "Vertebrae" for "Chimpanzee." All boxes must be correctly selected for full credit. To identify the traits that each animal possesses based on the cladogram, the correct responses are "Placenta" for "Chimpanzee," "Vertebrae" for all four animals, "Mammary glands" for "Chimpanzee" and "Kangaroo," and "Two pairs of limbs" for "Bullfrog," "Chimpanzee" and "Kangaroo."

Sample Response: 0 points

The evolutionary relationships among four animals and four animal traits are shown in the cladogram.



Select the boxes to identify the trait(s) that each animal possesses.

	Bullfrog	Chimpanzee	Kangaroo	Shark
Placenta	☑	☐	☐	☑
Vertebrae	☐	☑	☑	☐
Mammary glands	☑	☐	☐	☑
Two pairs of limbs	☑	☑	☑	☐

Notes on Scoring

This response earns no credit (0 points) because it does not identify "Placenta" for "Chimpanzee," "Vertebrae" for "Bullfrog" and "Shark," and "Mammary glands" for "Chimpanzee" and "Kangaroo." All boxes must be correctly selected for full credit. To identify the traits that each animal possesses based on the cladogram, the correct responses are "Placenta" for "Chimpanzee," "Vertebrae" for all four animals, "Mammary glands" for "Chimpanzee" and "Kangaroo," and "Two pairs of limbs" for "Bullfrog," "Chimpanzee" and "Kangaroo."

Biology
Practice Test

Question 22

Question and Scoring Guidelines

Question 22

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.

A C G T U

Delete

Universal Genetic Code Chart

Messenger RNA Codons and Amino Acids for Which They Code

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU, UUC: PHE; UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR; UAA, UAG: STOP	UGU, UGC: CYS; UGA: STOP; UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS; CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	AGU, AGC: SER; AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	C	C	G	A	C	C	G	A	C	C	T	T	A

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "T" placed at position 11 or 12

  AND

- "G," "T" or "C" placed at position 6

  OR

- "A," "T" or "C" placed at position 9

  OR

- "G" placed at position 15 (1 point).

Alignment

Topic
Heredity

Subtopic
Mutations

Content Elaboration
Genes are segments of DNA molecules. The sequence of DNA bases in a chromosome determines the sequence of amino acids in a protein. Inserting, deleting or substituting segments of DNA molecules can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm or have little or no effect on the offspring's success in its environments.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires student to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item
This item requires the student to understand the processes of transcription, translation and protein synthesis to use a DNA code to determine point mutations that would produce specific results during protein synthesis. The messenger RNA is coded from the DNA strand provided. In order to create a point mutation to shorten the protein created, a nucleotide "T" could be placed at position 11 or 12 of the DNA strand. In order to produce a point mutation that would not provide a change in the protein, a nucleotide "G," "T" or "C" can be placed at position 6; "A," "T" or "C" at position 9; or "G" at position 15.

Biology
Practice Test

Question 22

Sample Responses

Sample Response: 1 point

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.

A C G T U

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A	AUU, AUC, AUA: ILE; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	AGU, AGC: SER; AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	C	C	G	C	C	C	G	A	C	T	T	T	A

Notes on Scoring

This response earns full credit (1 point) because it correctly places a "T" at location 12 for Part A and a "C" at location 6 for Part B. A full-credit (1 point) response requires placement of a "T" at position 11 or 12 for Part A AND placement of a "C", "G" or "T" at position 6 for Part B OR placement of an "A", "C" or "T" at position 9 OR placement of a "G" at position 15.

Sample Response: 1 point

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
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DNA	T	A	C	C	G	A	C	C	G	A	C	T	T	T	G

Notes on Scoring

This response earns full credit (1 point) because it correctly places "T" at position 12 and "G" at position 15. A full-credit response includes "T" placed at position 11 or 12 AND "G," "T" or "C" placed at position 6, OR "A," "T" or "C" placed at position 9, OR "G" placed at position 15.

Sample Response: 0 points

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
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G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	T	C	G	T	C	C	C	A	C	G	T	T	A

Notes on Scoring

This response earns no credit (0 points) because it incorrectly places "T" at position 3 and "G" at position 12. A full-credit response includes "T" placed at position 11 or 12 AND "G," "T" or "C" placed at position 6, OR "A," "T" or "C" placed at position 9, OR "G" placed at position 15.

Sample Response: 0 points

When DNA mutations occur, they can have a variety of effects on an organism.

A. Place a nucleotide in the DNA sequence to create a point mutation that would shorten the protein.

B. Place a nucleotide in the DNA sequence to create a point mutation that would **not** produce a change in the protein.

- You do **not** need to use all the nucleotides.
- You may use a nucleotide more than once.
- There may be more than one correct answer.

A C G T U

Delete

Universal Genetic Code Chart

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C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS; CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	AGU, AGC: SER; AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

DNA	T	A	G	C	G	A	C	C	A	A	C	T	T	T	G

Notes on Scoring

This response earns no credit (0 points) because it incorrectly places "G" at position 3. Placement of the other nucleotides is correct. A full-credit response includes "T" placed at position 11 or 12 AND "G," "T" or "C" placed at position 6, OR "A," "T" or "C" placed at position 9, OR "G" placed at position 15.

Biology
Practice Test

Question 23

Question and Scoring Guidelines

Question 23

A scientist is trying to determine the evolutionary relationships among species with very similar physical characteristics. One method to determine the relationships is by comparing amino acid sequences of proteins.

Why would the scientist compare the amino acid sequences of proteins common to those similar species?

(A) Amino acid sequence differences provide evidence of gene flow among the species.

(B) Amino acid sequence differences reflect the accumulated differences in the DNA of the species.

(C) Amino acid sequence differences are the only useful data for constructing accurate cladograms of the species.

(D) Amino acid sequence differences are the result of mutations caused by different selection pressures experienced by the species.

Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

Rationale for Option A: This is incorrect. Amino acid sequence comparison does not provide any evidence of gene flow.

Rationale for Option B: **Key** – Amino acid sequence differences are based on differences in DNA base sequences due to accumulated mutations.

Rationale for Option C: This is incorrect. Amino acid sequence comparison is one of many data sources useful in constructing cladograms.

Rationale for Option D: This is incorrect. Amino acid sequence differences are not caused by selection pressures.

Alignment

Topic
Diversity and Interdependence of Life

Subtopic
Classification systems are frameworks created by scientists for describing the vast diversity of organisms, indicating the degree of relatedness between organisms.

Content Elaboration
Building on knowledge from elementary school (interactions of organisms within their environment and the law of conservation of matter and energy, food webs) and from middle school (flow of energy through organisms, biomes and biogeochemical cycles), this topic focuses on the study of diversity and similarity at the molecular level of organisms.

Classification systems are frameworks developed by scientists for describing the diversity of organisms, indicating the degree of relatedness between organisms. Recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons. Both morphological comparisons and molecular evidence must be used to describe biodiversity (cladograms can be used to address this).

Cognitive Demand
Recalling Accurate Science (R)

Requires students to provide accurate statements about scientifically valid facts, concepts and relationships. Recall only requires students to provide a rote response, declarative knowledge or perform routine mathematical tasks. This cognitive demand refers to students' knowledge of science fact, information, concepts, tools, procedures (being able to describe how) and basic principles.

Explanation of the Item
This item requires the student to understand why amino acid sequence comparisons can provide information on evolutionary relationships. Amino acid sequence differences are based on differences in DNA base sequences due to accumulated mutations.

Sample Response: 1 point

A scientist is trying to determine the evolutionary relationships among species with very similar physical characteristics. One method to determine the relationships is by comparing amino acid sequences of proteins.

Why would the scientist compare the amino acid sequences of proteins common to those similar species?

Ⓐ Amino acid sequence differences provide evidence of gene flow among the species.

● Amino acid sequence differences reflect the accumulated differences in the DNA of the species.

Ⓒ Amino acid sequence differences are the only useful data for constructing accurate cladograms of the species.

Ⓓ Amino acid sequence differences are the result of mutations caused by different selection pressures experienced by the species.

Biology
Practice Test

Question 24

Question and Scoring Guidelines

Question 24

The following question has two parts. First, answer part A. Then, answer part B.

Part A

About 4,500 years ago two cheetah subspecies arose from a common ancestor. The table contains data comparing the two cheetah subspecies.

Cheetah Subspecies Comparison Table

Cheetah Subspecies	*A.j. jubatus*	*A.j. raineyi*
Location	Southern Africa	Eastern Africa
Number of Alleles Unique to Subspecies	72	92
Number of Alleles Shared with Common Ancestor	136	136

Which subspecies is genetically more closely related to its common ancestor?

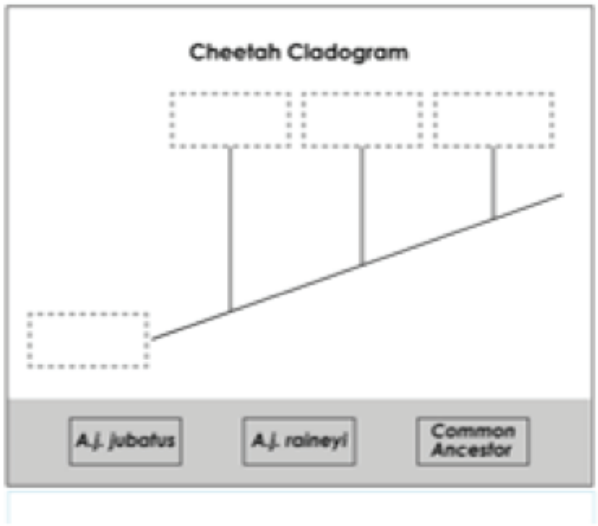
Ⓐ *A.j. jubatus*

Ⓑ *A.j. raineyi*

Part B

Move the cheetah subspecies and their common ancestor into the blank boxes on the cladogram to show the evolutionary relationships identified in part A.

- You will **not** need to fill in all of the blank boxes.



Points Possible: 1

See **Alignment** for more detail.

Scoring Guidelines

For this item, a full-credit response includes:

- "*A.j. jubatus*" selected for part A;

  AND

- "*Common Ancestor*" moved into the first box on the bottom left;

  AND

- "*A.j. jubatus*" moved into the second box from the left;

  AND

- "*A.j. raineyi*" moved into the third box from the left for part B (1 point).

Alignment

Topic
Evolution

Subtopic
Diversity of Life

Content Elaboration
The basic concept of biological evolution is that Earth's present-day species descended from earlier, common ancestral species. At the high school level the term natural selection is used to describe the process by which traits become more or less common in a population due to consistent environmental effects upon the survival or reproduction of the individual with the trait.

Cognitive Demand
Interpreting and Communicating Science Concepts (C)

Requires students to use subject-specific conceptual knowledge to interpret and explain events, phenomena, concepts and experiences using grade-appropriate scientific terminology, technological knowledge and mathematical knowledge. Communicate with clarity, focus and organization using rich, investigative scenarios, real-world data and valid scientific information.

Explanation of the Item

This item requires the student to identify which of two subspecies are most closely related to the common ancestor based on the data in the *Cheetah Subspecies Comparison Table*. Once the student identifies the correct subspecies, the student then completes a cladogram reflecting the evolutionary relationships. To determine the subspecies most closely related to the common ancestor, the student would select the species with the least number of alleles unique to the subspecies. Referring to the table, the *A.j. jubatus* subspecies has the least with 72 unique alleles. Therefore, the correct response is "A". To identify the correct evolutionary relationships, the common ancestor would be placed in the far-left box at the beginning of the diagonal line. Then, the *A.j. jubatus* subspecies would be placed in the first box to the right, depicting *A.j. jubatus* as the closest relative. The subspecies *A.j. raineyi* would be placed in the next box to the right, showing *A.j. raineyi* as the next most closely related.

Biology
Practice Test

Question 24

Sample Responses

Sample Response: 1 point

The following question has two parts. First, answer part A. Then, answer part B.

Part A

About 4,500 years ago two cheetah subspecies arose from a common ancestor. The table contains data comparing the two cheetah subspecies.

Cheetah Subspecies Comparison Table

Cheetah Subspecies	*A.j. jubatus*	*A.j. raineyi*
Location	Southern Africa	Eastern Africa
Number of Alleles Unique to Subspecies	72	92
Number of Alleles Shared with Common Ancestor	136	136

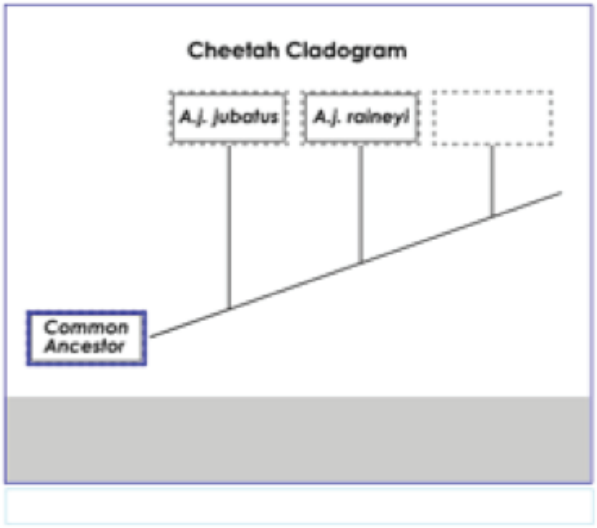
Which subspecies is genetically more closely related to its common ancestor?

- ● *A.j. jubatus*
- ◉ *A.j. raineyi*

Part B

Move the cheetah subspecies and their common ancestor into the blank boxes on the cladogram to show the evolutionary relationships identified in part A.

- You will **not** need to fill in all of the blank boxes.



Notes on Scoring

This response earns full credit (1 point) because it correctly identifies the subspecies that is genetically most closely related to the common ancestor, and it correctly completes the cladogram to illustrate that relationship.

Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

About 4,500 years ago two cheetah subspecies arose from a common ancestor. The table contains data comparing the two cheetah subspecies.

Cheetah Subspecies Comparison Table

Cheetah Subspecies	*A.j. jubatus*	*A.j. raineyi*
Location	Southern Africa	Eastern Africa
Number of Alleles Unique to Subspecies	72	92
Number of Alleles Shared with Common Ancestor	136	136

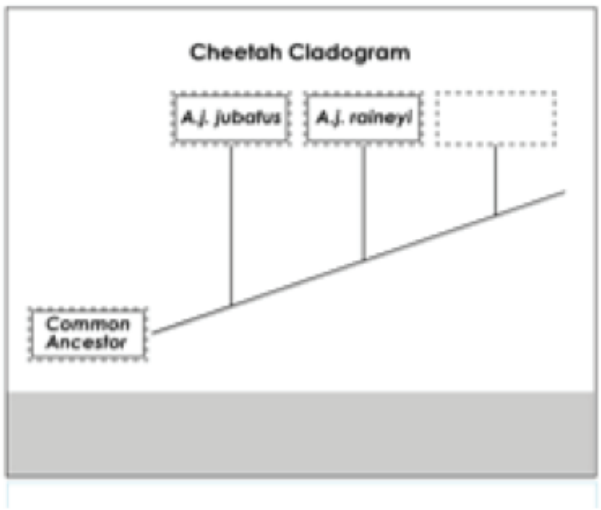
Which subspecies is genetically more closely related to its common ancestor?

- Ⓐ *A.j. jubatus*
- ● *A.j. raineyi*

Part B

Move the cheetah subspecies and their common ancestor into the blank boxes on the cladogram to show the evolutionary relationships identified in part A.

- You will **not** need to fill in all of the blank boxes.



Notes on Scoring

This response earns no credit (0 points) because it does not correctly identify the subspecies that is genetically most closely related to the common ancestor in part A. Although part B is correct, part A and part B are linked, and both must be correct in order for the response to earn 1 point.

Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

About 4,500 years ago two cheetah subspecies arose from a common ancestor. The table contains data comparing the two cheetah subspecies.

Cheetah Subspecies Comparison Table

Cheetah Subspecies	*A.j. jubatus*	*A.j. raineyi*
Location	Southern Africa	Eastern Africa
Number of Alleles Unique to Subspecies	72	92
Number of Alleles Shared with Common Ancestor	136	136

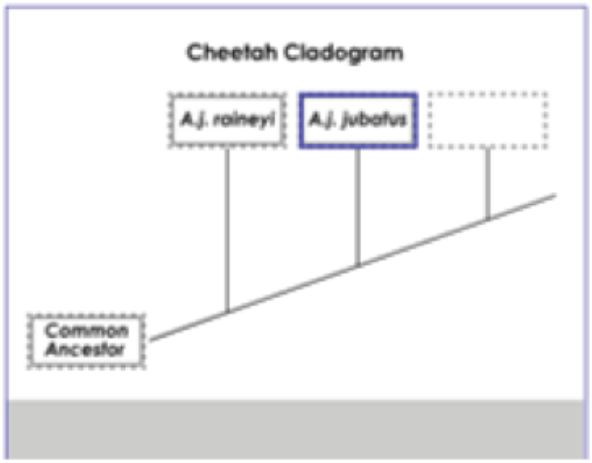
Which subspecies is genetically more closely related to its common ancestor?

- ● *A.j. jubatus*
- ○ *A.j. raineyi*

Part B

Move the cheetah subspecies and their common ancestor into the blank boxes on the cladogram to show the evolutionary relationships identified in part A.

- You will **not** need to fill in all of the blank boxes.



Notes on Scoring

This response earns no credit (0 points) because it incorrectly completes the cladogram to identify the subspecies that is genetically most closely related to the common ancestor. Although part A is correct, part A and part B are linked, and both must be correct in order for the response to earn 1 point.

Sample Response: 0 points

The following question has two parts. First, answer part A. Then, answer part B.

Part A

About 4,500 years ago two cheetah subspecies arose from a common ancestor. The table contains data comparing the two cheetah subspecies.

Cheetah Subspecies Comparison Table

Cheetah Subspecies	*A.j. jubatus*	*A.j. raineyi*
Location	Southern Africa	Eastern Africa
Number of Alleles Unique to Subspecies	72	92
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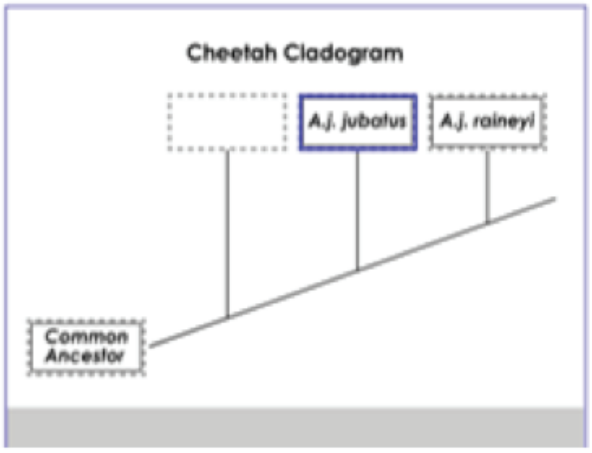
Which subspecies is genetically more closely related to its common ancestor?

- ● *A.j. jubatus*
- ⓑ *A.j. raineyi*

Part B

Move the cheetah subspecies and their common ancestor into the blank boxes on the cladogram to show the evolutionary relationships identified in part A.

- You will **not** need to fill in all of the blank boxes.



Notes on Scoring

This response earns no credit (0 points) because it incorrectly completes the cladogram to identify the subspecies that is genetically most closely related to the common ancestor. Although part A is correct, part A and part B are linked, and both must be correct in order for the response to earn 1 point.